



## LVDS Network Camera System

Panasonic Electronic Devices  
Panasonic Communications  
Company  
Molex Japan  
Ansoft



# Seminar Contents

- Introducing **Panasonic**
- Defining the Project
- Approaching to the Project
- Improving the Design
- **EYE Design** Tools from **Ansoft**
- Activity Introduction with **Molex Japan**
- Conclusion



# Main Domains of Panasonic Group

Matsushita Electric Industrial Co., Ltd  
Head Office (Group & Global)

## AVC Networks

Panasonic AVC Networks Company
Panasonic Communications Co., Ltd.
Panasonic Mobile Communications Co., Ltd.
Panasonic Automotive Systems Company
Panasonic System Solutions Company
Panasonic Shikoku Electronics Co., Ltd.

## Appliances

Matsushita Home Appliances Company
Healthcare Business Company
Lighting Company
Matsushita Ecology Systems Co., Ltd.

## Devices

Semiconductor Company
Panasonic Electronic Devices Co., Ltd.
Matsushita Battery Industrial Co., Ltd.
Motor Company

Matsushita Electric Works, Ltd.

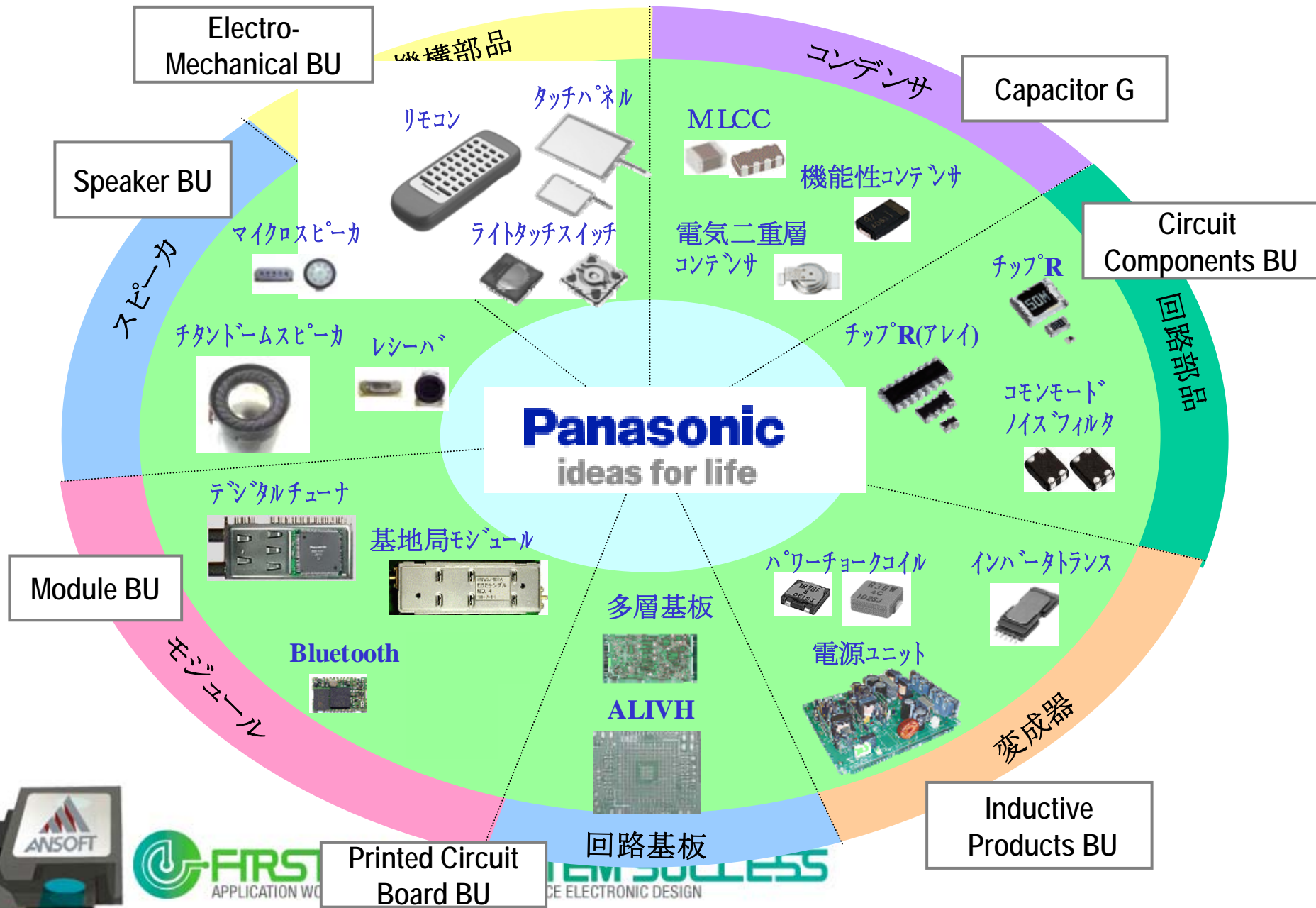
PanaHome Corporation

Victor Company of Japan, Ltd.

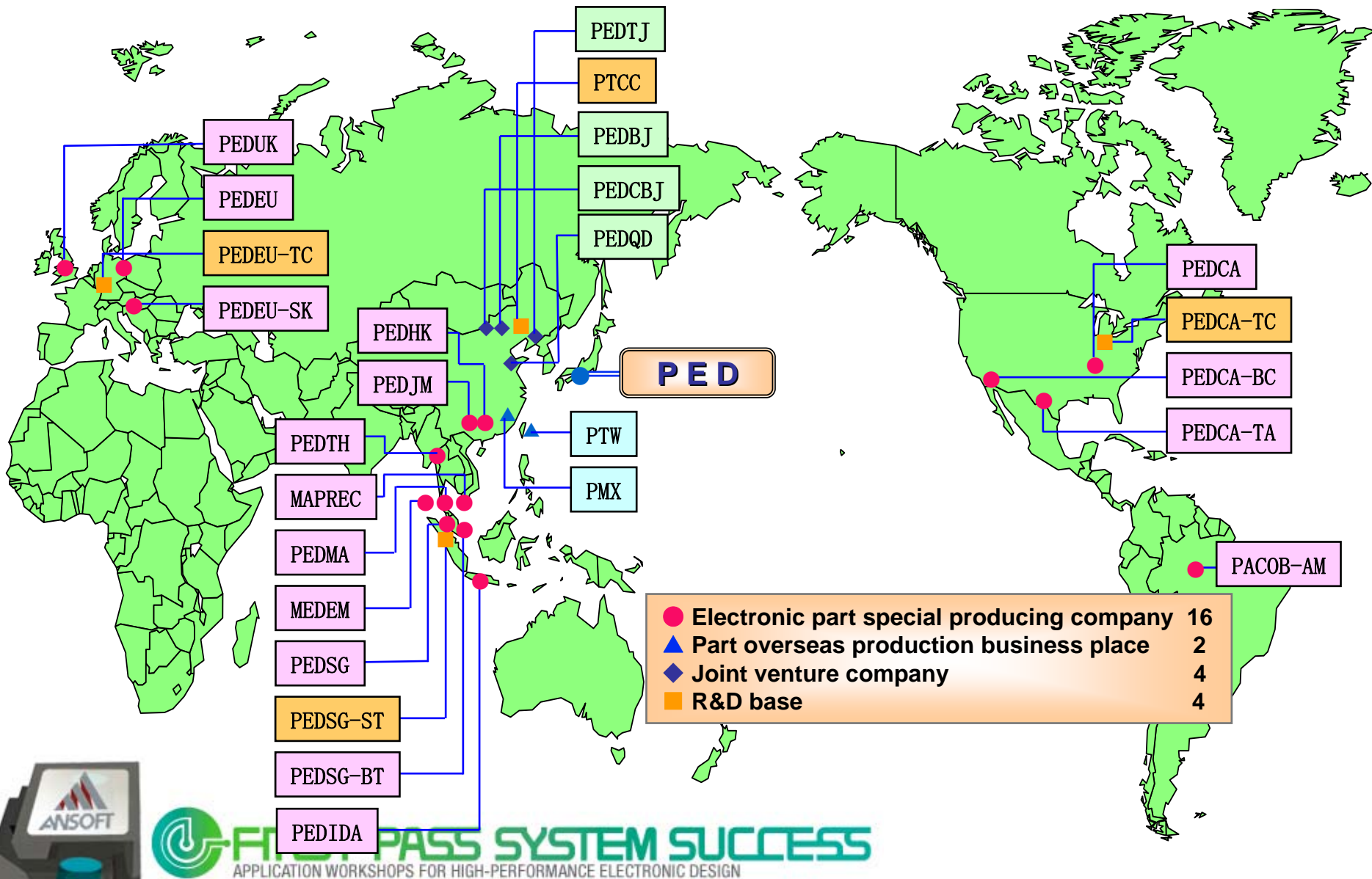
## Others

Panasonic Factory Solutions Co., Ltd.
Matsushita Welding Systems Co., Ltd.
Others

# Main Products in PED



# Global production and R&D base list





# LCR Solution on PED WEB Site

<http://panasonic.co.jp/ped/>

## Device Library

• • • Data Library  
for simulation

• • • Noise Suppression Solution

• • • Device selection guide

• • • Capacitor Selection Guide

• • • Device selection guide

**Panasonic**  
ideas for life

> Search Keyword

Search

**Panasonic Electronic Devices Co.,Ltd.**

Products

Corporate Profile

Products  
Information

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Device Library as components  
for design tool of Agilent,  
Ansoft and AWR

Noise Suppression  
Solutions

SMD Capacitor Selection Guide



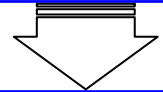
**FIRST-PASS SYSTEM SUCCESS**  
APPLICATION WORKSHOPS FOR HIGH-PERFORMANCE ELECTRONIC DESIGN

# Purpose of Device Library

## Customer/Set

### 【Conventional】

Catalog retrieval



Sample order



Circuit design and  
Experimental  
evaluation



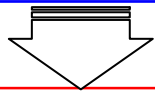
Device selection



Experimental  
evaluation

### 【Current】

Catalog retrieval on WEB

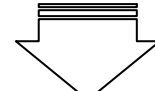


Circuit design(simulation)



Device selection

Sample order on WEB



Experimental  
evaluation

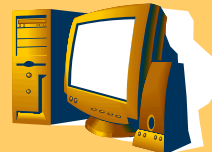
Circuit design process

## PED/Device

<http://industrial.panasonic.com/i/library.html>

### Simulator

High frequency circuit & system  
design tool



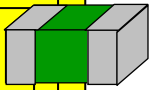
Please downloads from Web  
and registers it as a component  
for the simulator.



Improvement of  
design perfection

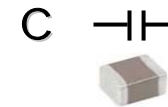
Efficiency  
improvement of  
design

Device  
Parameter



S Parameter  
Equivalent circuit model

例) Capacitor



●Chip multi-layer  
ceramic capacitors  
< MLCC's >  
( 270 parts numbers )

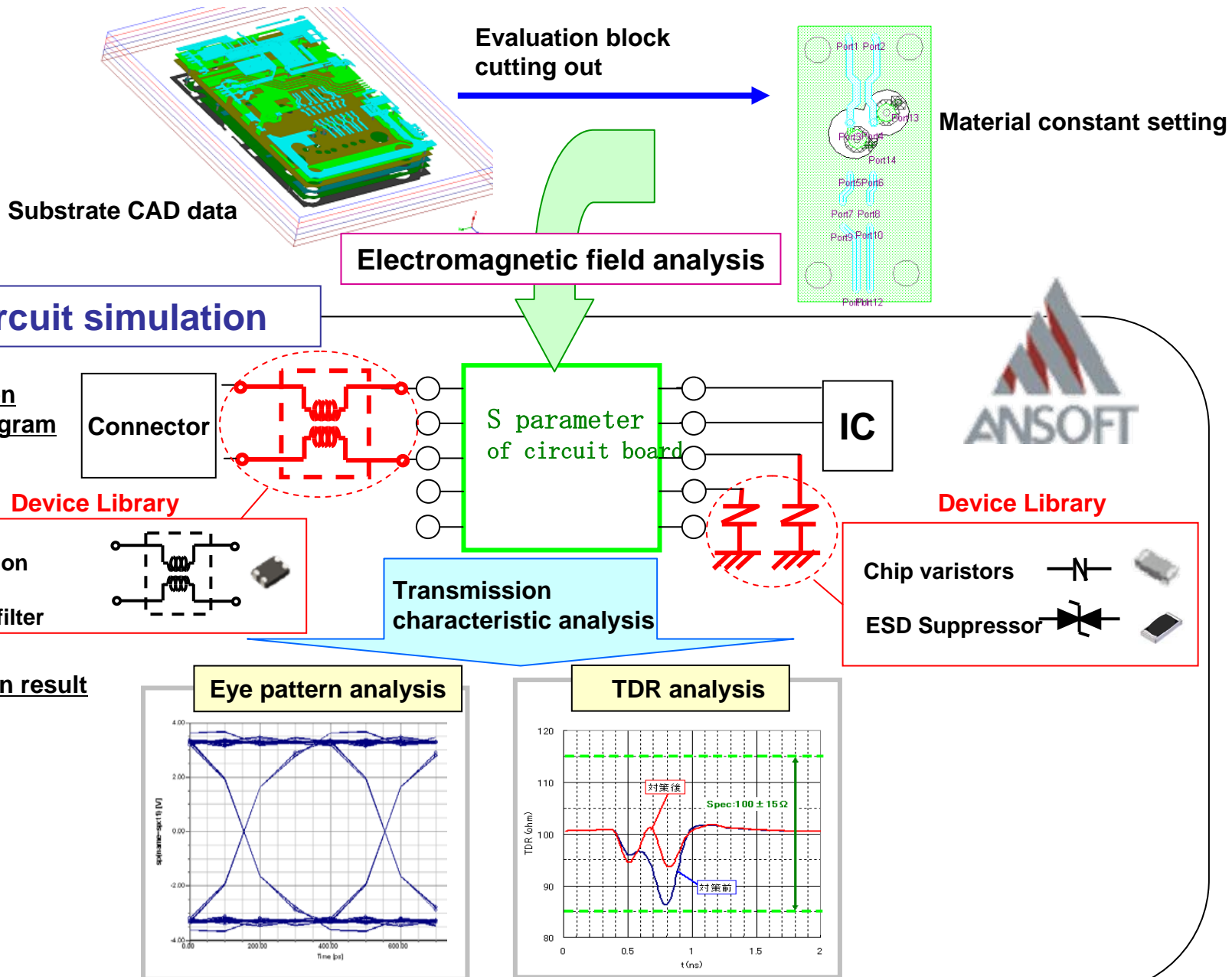


●Chip resistors  
( 186 parts numbers )



●Chip inductors  
( 45 parts  
numbers )

# Simulation analysis with substrate CAD data and Device Library





# LCR solution activity flow

Plan

Development step of set circuit design

Mass

production

Circuit design

Making  
for trial purposes

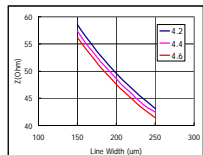
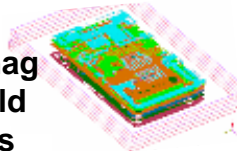
Evaluation

## Simulation

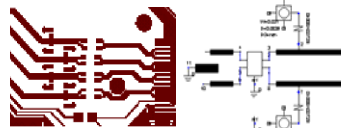
Device selection and recommended  
pattern proposal



Electromag  
netic field  
analysis



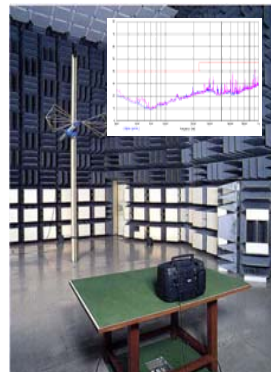
Impedance  
design



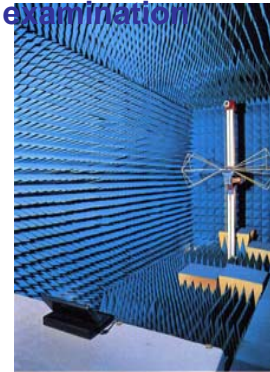
Circuit simulation

Selection of the  
best parts

Radiation obstruction  
wave measurement



Electromagnetic radiate  
field immunity  
examination

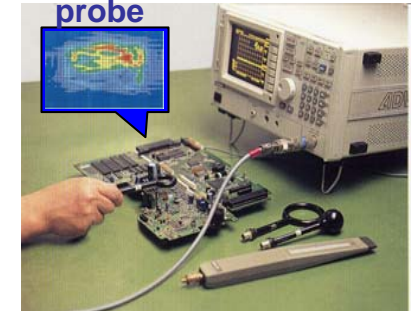


Conduction obstruction wave  
voltage measurement

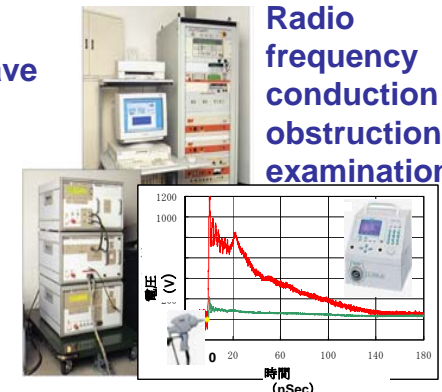


## Noise evaluation at EMC Site

Analysis by  
electromagnetic field  
probe



Radio  
frequency  
conduction  
obstruction  
examination



① Solution corresponding to design phase

② Total solution with a lot of devices



**FIRST-PASS SYSTEM SUCCESS**  
APPLICATION WORKSHOPS FOR HIGH-PERFORMANCE ELECTRONIC DESIGN



# Demand of Remote IP Monitoring



I want to monitor my branch shops at any time, any place.  
**(Franchise retail store owner)**



I want to check the present Condition or change for large facility.  
**(Parking lot, warehouse)**



I want to check branches to make sure if everything is fine  
**(Branch, factory, school)**



I want to improve customer satisfaction, energy saving  
**(Building, apartment, hotel)**



I want to install Security system, but expensive!  
I need something at reasonable cost .

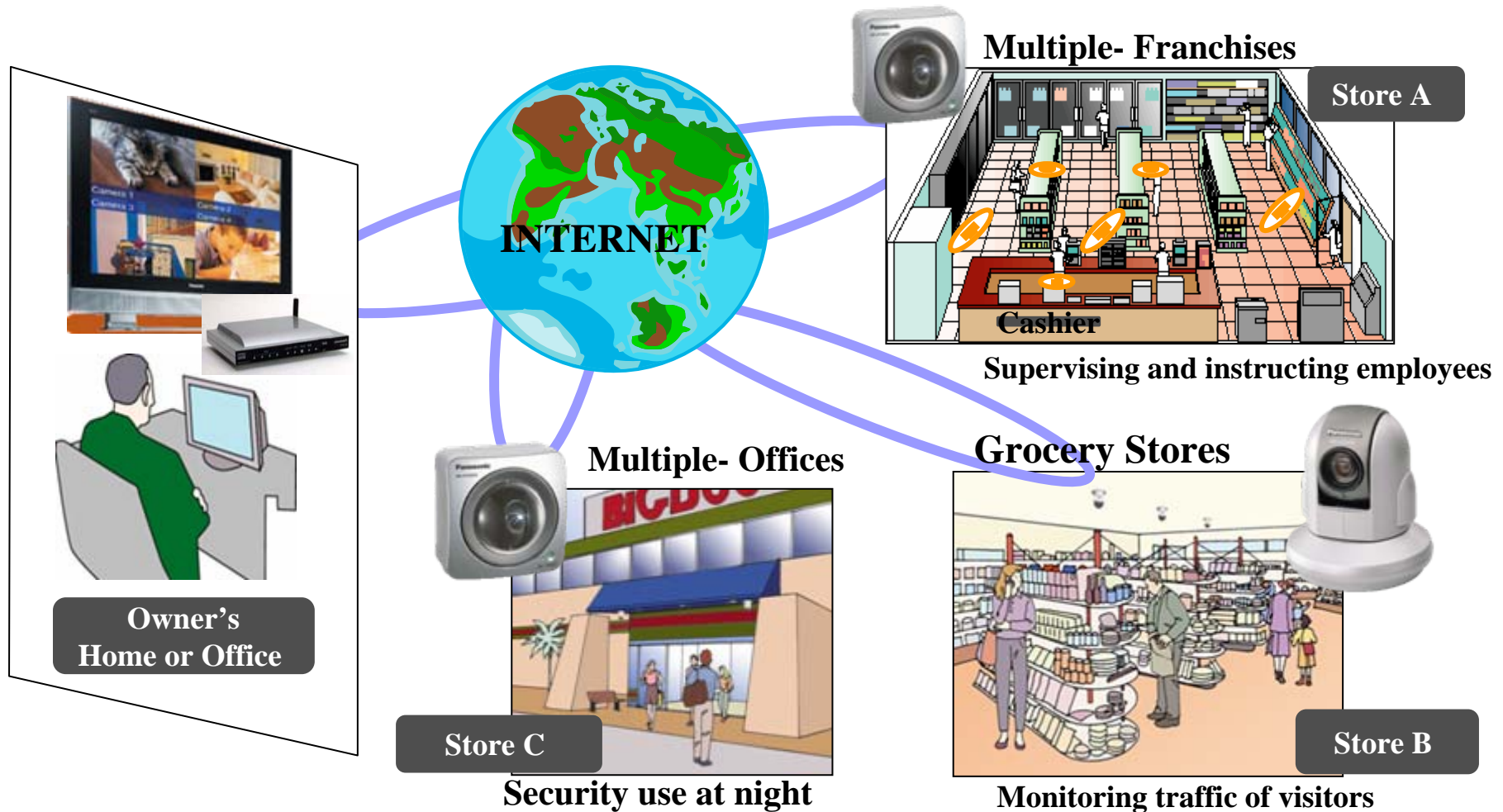


I want to make HP more attractive.  
**(Live monitoring)**



**Remote IP Monitoring corresponds to such needs!!**

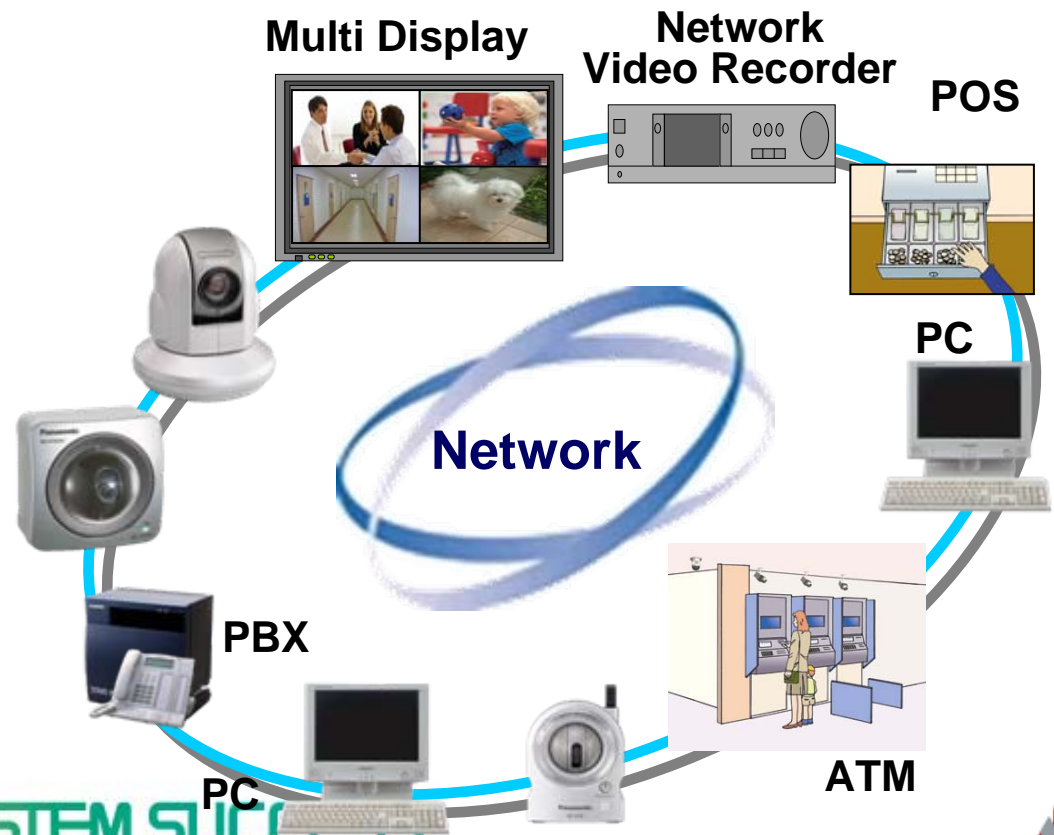
# ZDM [Zero Distance Management]



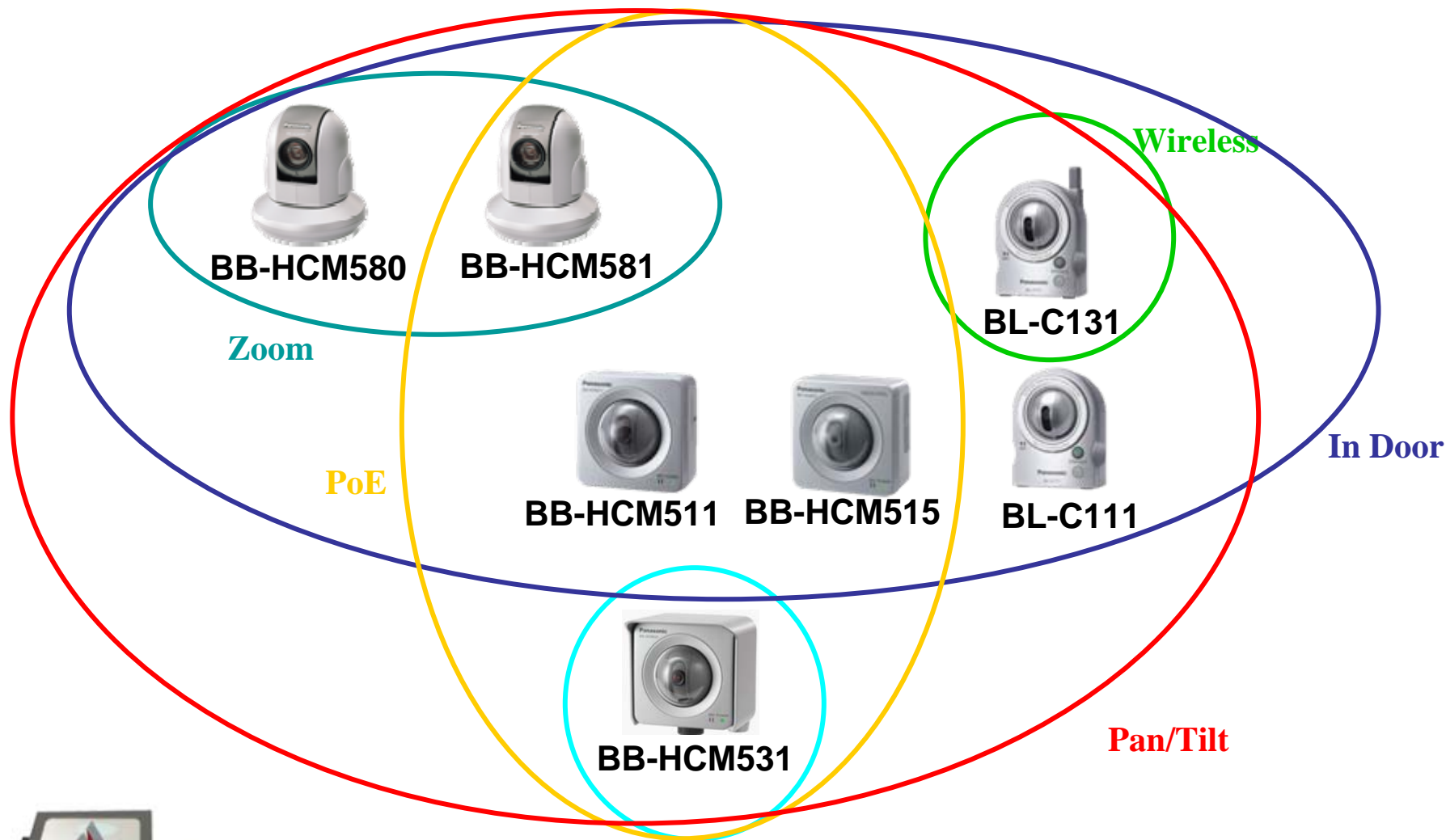
Improve the **Quality of Management** by IP Monitoring



- **Distance Free!**
- **High Reliability!**
- **Save Time & Cost!**
- **Integration with IP-PBX, POS, ATM!**



# Network Camera Line up





# Introducing Project Definitions



# Motivation of the Project

- **Panasonic** to employ **Computer Aided Engineering** in their System.
  - Time to Market...Initial Design to Product
  - Robust Design
    - **EYE Design**
    - **EMI/EMC Regulation**
- Establish the **methodology of designing products using Simulator** instead of Cut and Try method.



# Why not Cut and Try?

- If Engineer is lucky, then it will probably find solution quickly modifying the design.
- It all depends on the engineer's skill and experiences.
- Just making the prototype board takes 2 months and measurements takes additional one month.
- **CAE based approach** not just reveal all the problems but also gives path to **greatly enhance their products**.



# Ansoft Tools ready to Solve their requirements?

- **LVDS system in Network Camera is huge.** No Electromagnetic Simulator can possibly solve the entire problem.
- Ansoft has suggested to use **combination of Electromagnetic Simulator** as well as **Circuit Simulator** to find the causes of their prototype board.
- **PED/PCC/Molex Japan** together with **Ansoft** formed project to establish design flow using prototype boards. (System and Boards which failed.)
- **Knowledge and experiences** obtained through this project has been implemented in **Panasonic** for future products.



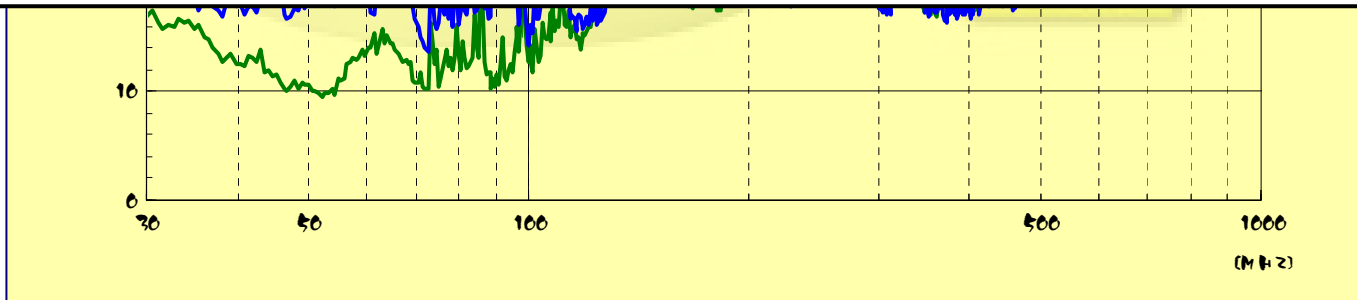
# Project Scope



**Maintain Quality Eye Diagram**

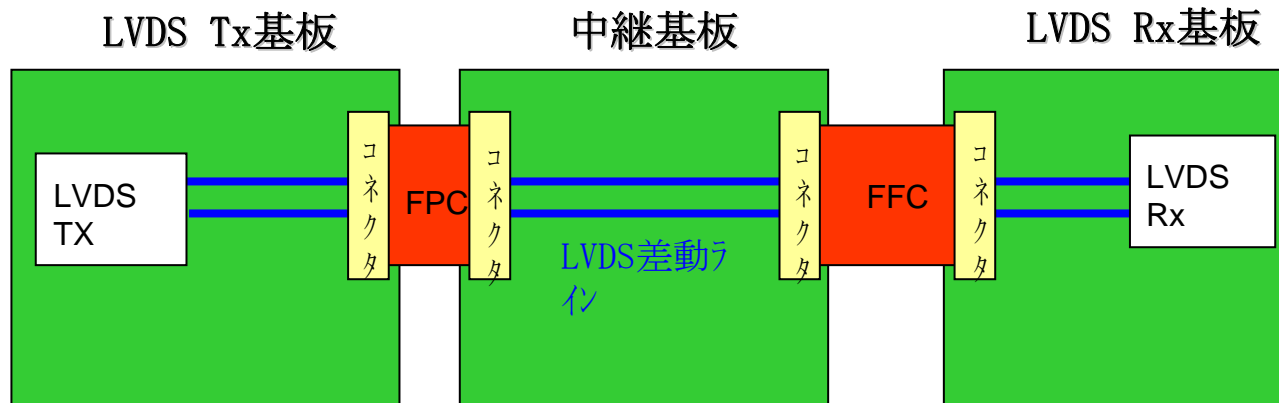
**Suppress Radiation Noise (EMI/EMC)**

**Implication is to reduce Common Mode Degeneration through out the system**





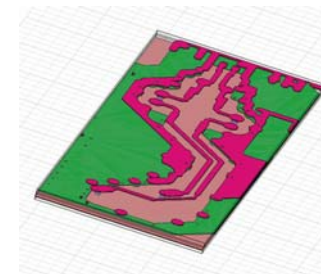
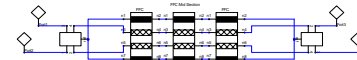
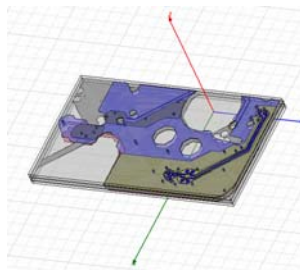
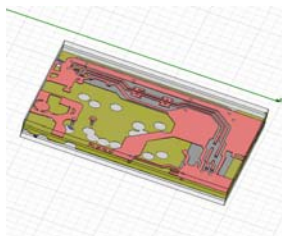
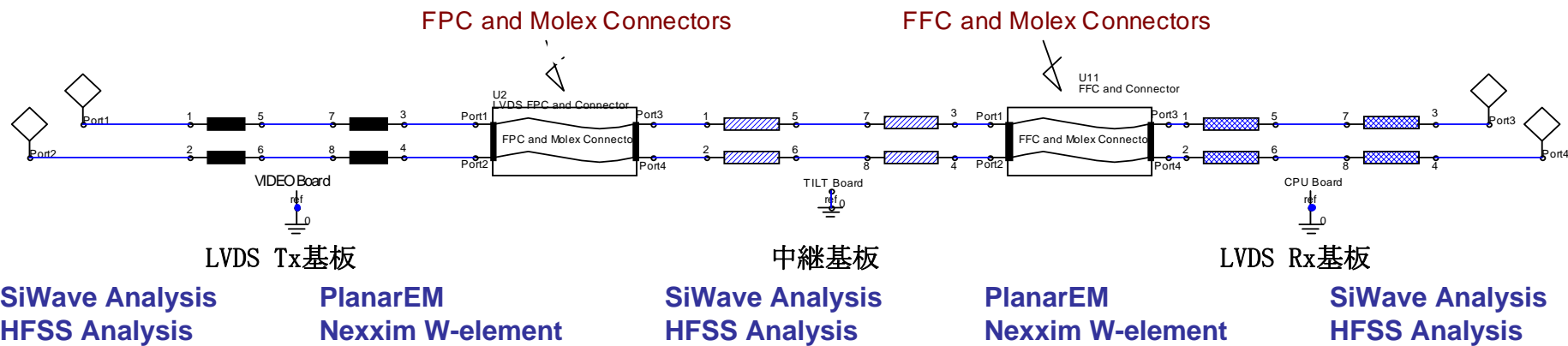
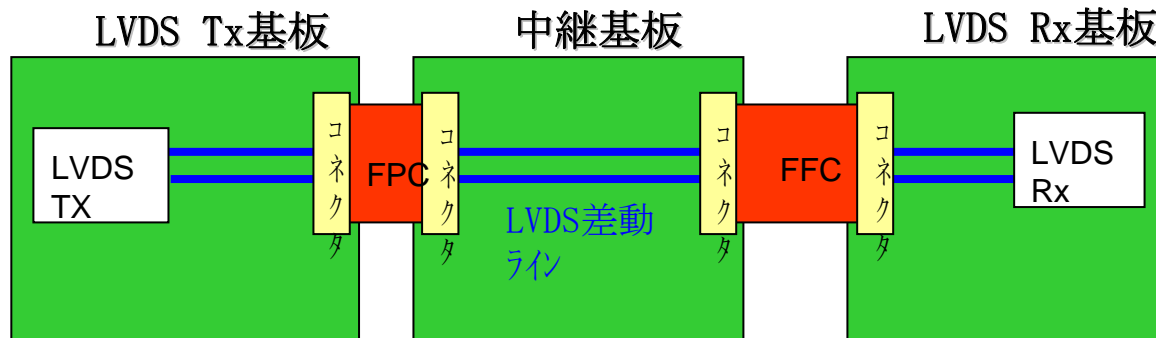
# Approaches to the Project



**Duplicate the System in Simulation**  
**Match to the Measurements if available**

**Use the system to improve the performance**

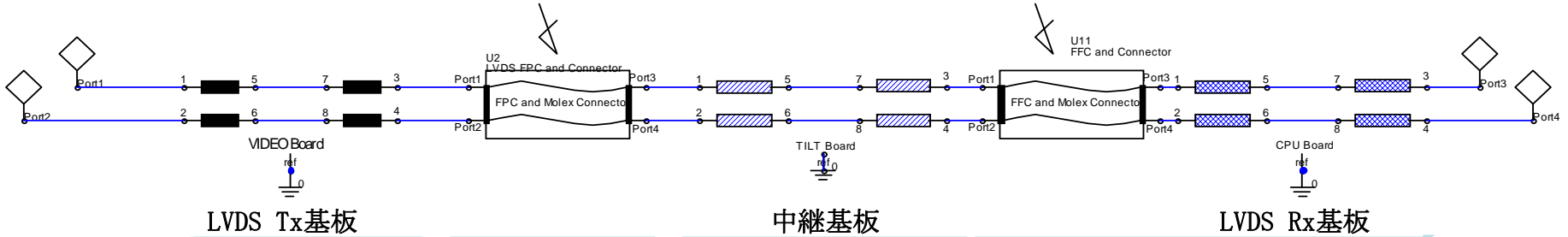


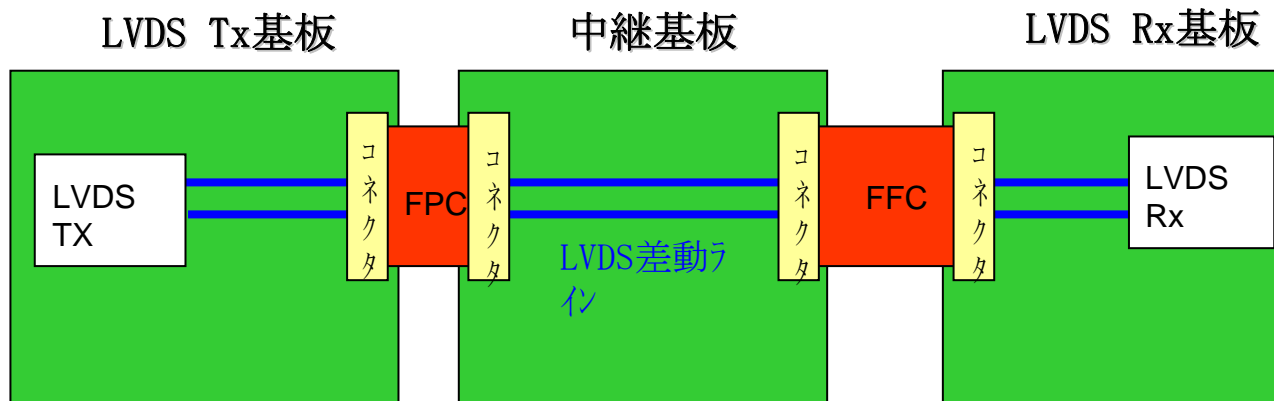


# Examine Total System

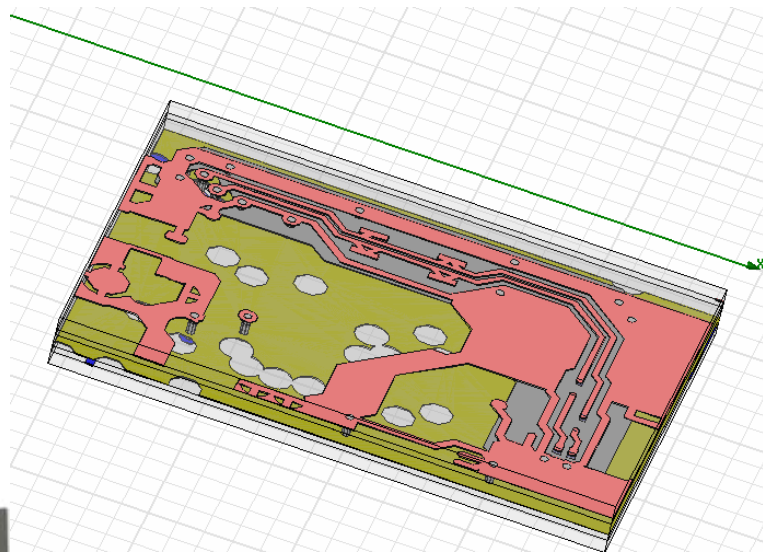
FPC and Molex Connectors

FFC and Molex Connectors

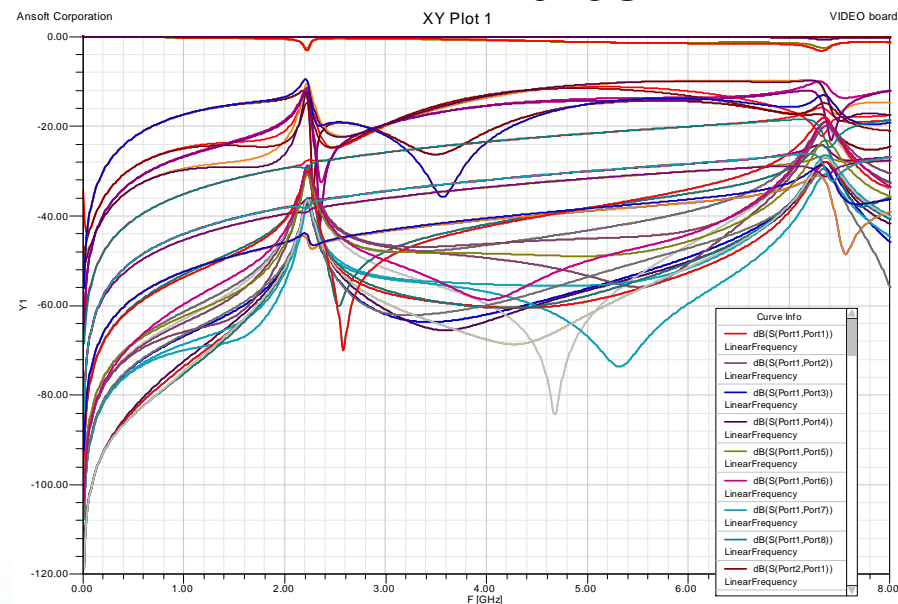




## LVDS Tx Board



**0~8GHz**

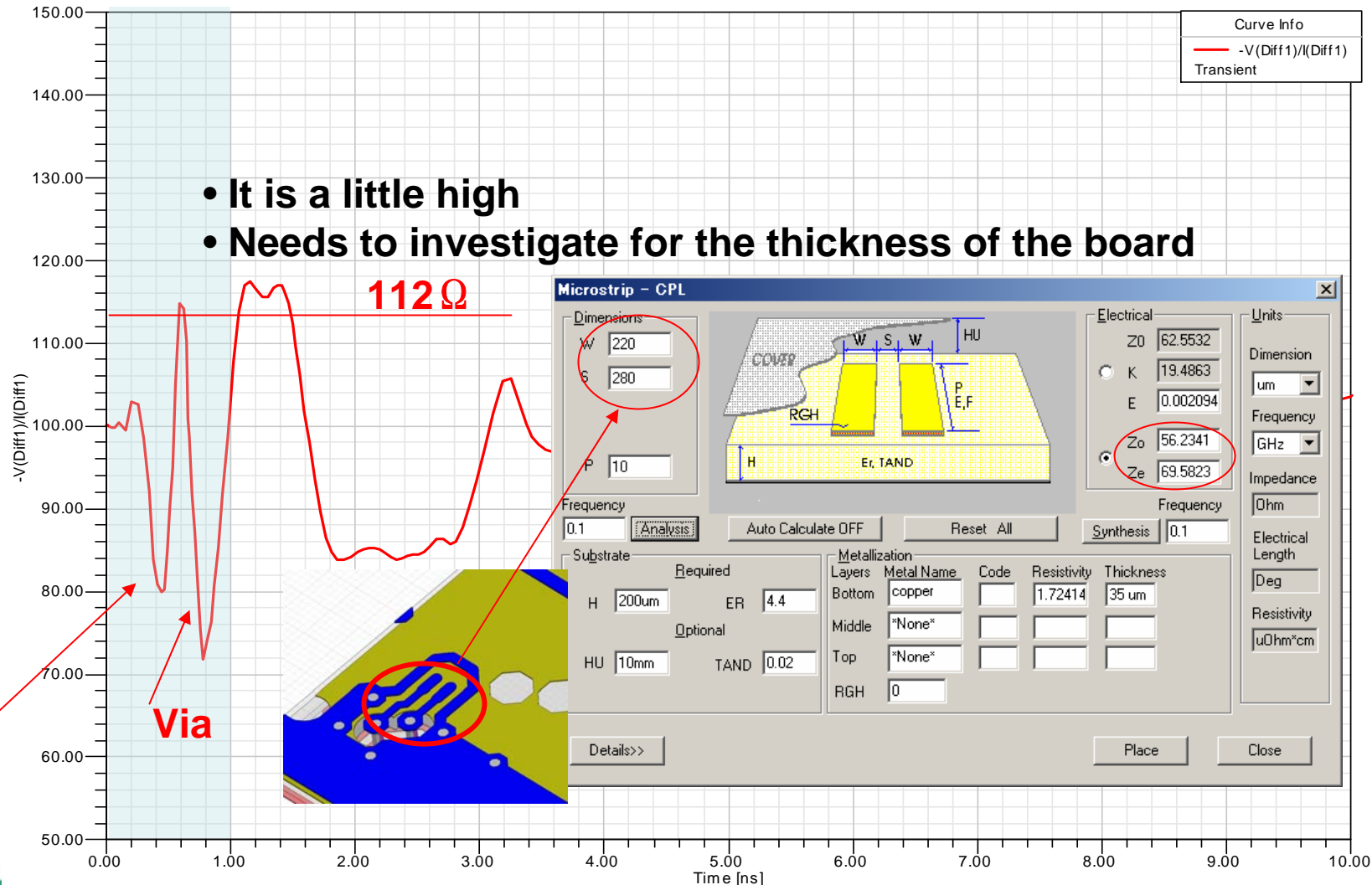


# Video Board Time Domain

Ansoft Corporation

Impedance

LVDS TDR folded





**Microstrip - CPL**

Dimensions  
W 220  
S 150  
P 10

Frequency  
0.1 [Analysis] Auto Calculate OFF Reset All Synthesis 0.1

Substrate  
Required H 200um ER 4.4  
Optional HU 10mm TAND 0.02

Metallization  
Layers Metal Name Code Resistivity Thickness  
Bottom copper 1.72414 35 um  
Middle "None"  
Top "None"  
RGH 0

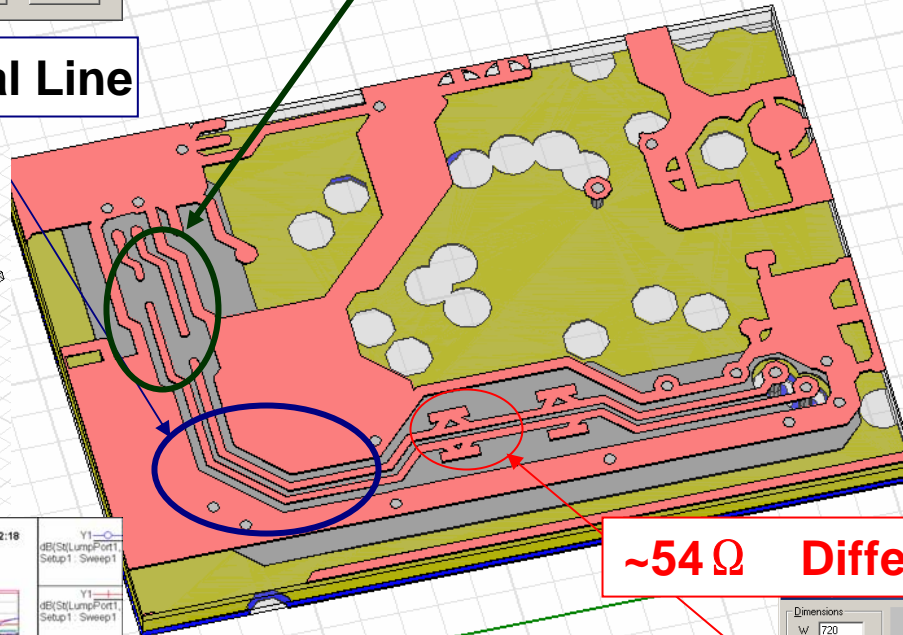
Electrical  
Z0 61.019  
K 14.3809  
E 0.002085  
Frequency 50.292 GHz  
Ze 74.0339  
Impedance Ohm  
Electrical Length Deg  
Resistivity uOhm\*cm

Units  
Dimension um

Place Close

May cause Skew if the components are placed.

**~100  $\Omega$  Differential Line**



**~54  $\Omega$  Differential Line**

**Microstrip - CPL**

Dimensions  
W 720  
S 150  
P 10

Frequency  
0.1 [Analysis] Auto Calculate OFF Reset All Synthesis 0.1

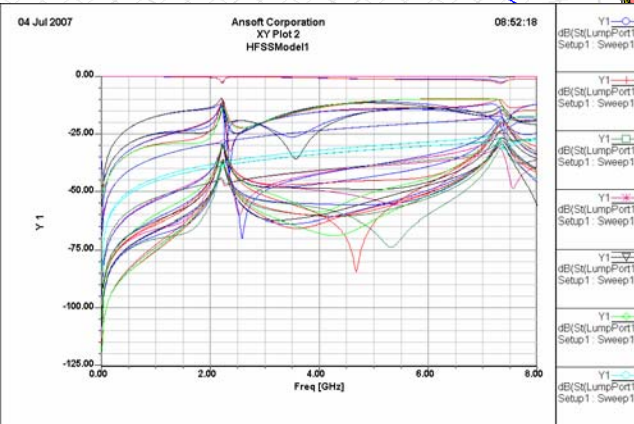
Substrate  
Required H 200um ER 4.4  
Optional HU 10mm TAND 0.02

Metallization  
Layers Metal Name Code Resistivity Thickness  
Bottom copper 1.72414 35 um  
Middle "None"  
Top "None"  
RGH 0

Electrical  
Z0 31.1462  
K 17.9448  
E 0.002218  
Frequency 50.292 GHz  
Ze 35.3773  
Impedance Ohm  
Electrical Length Deg  
Resistivity uOhm\*cm

Units  
Dimension um

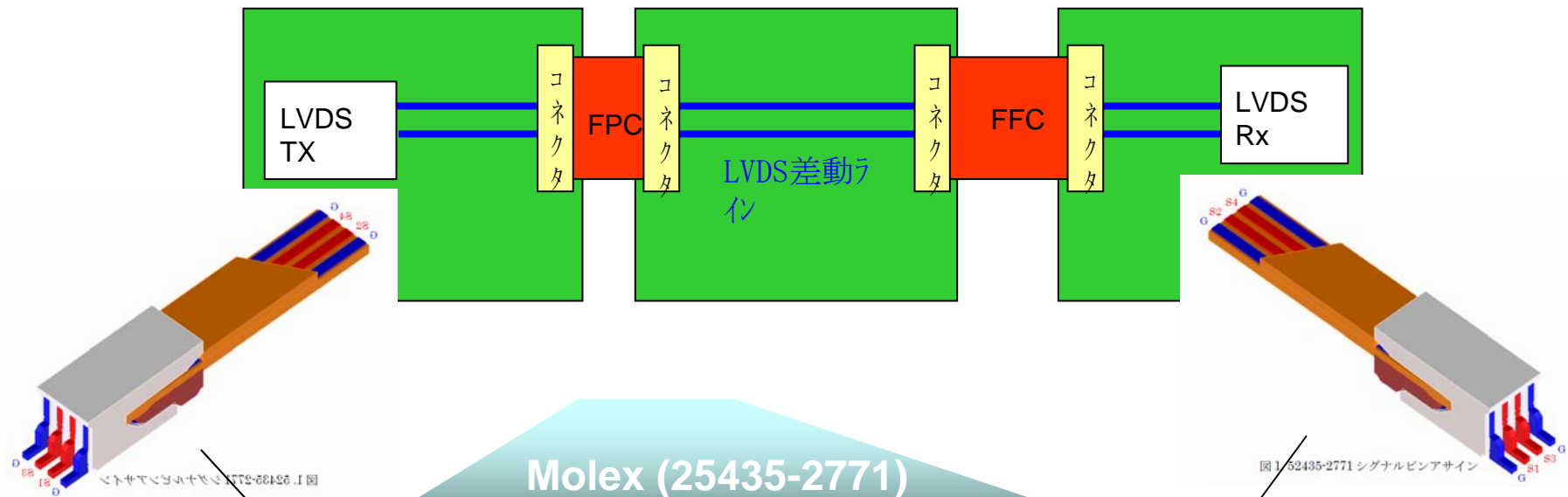
Place Close



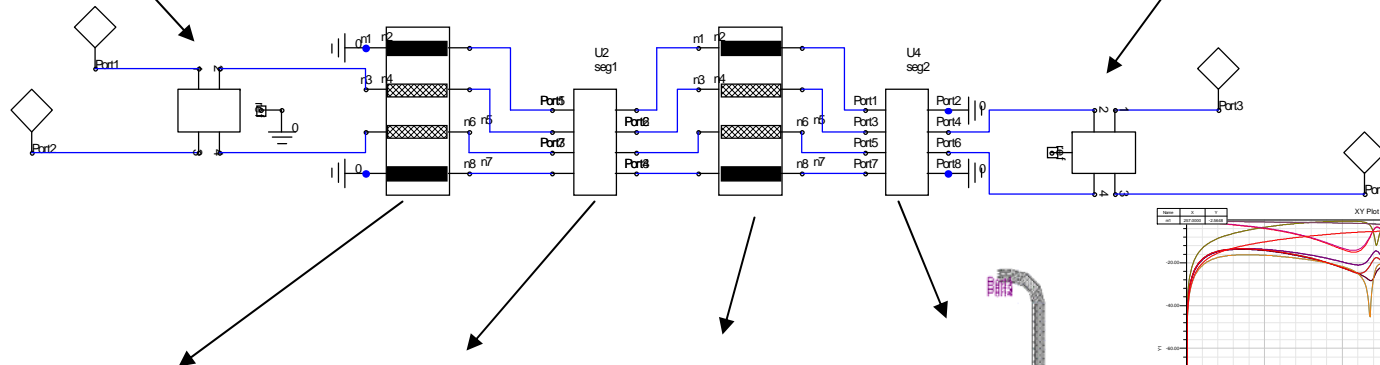
LVDS Tx基板

中継基板

LVDS Rx基板

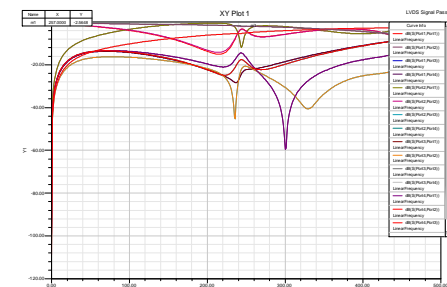


Molex (25435-2771)  
FPC

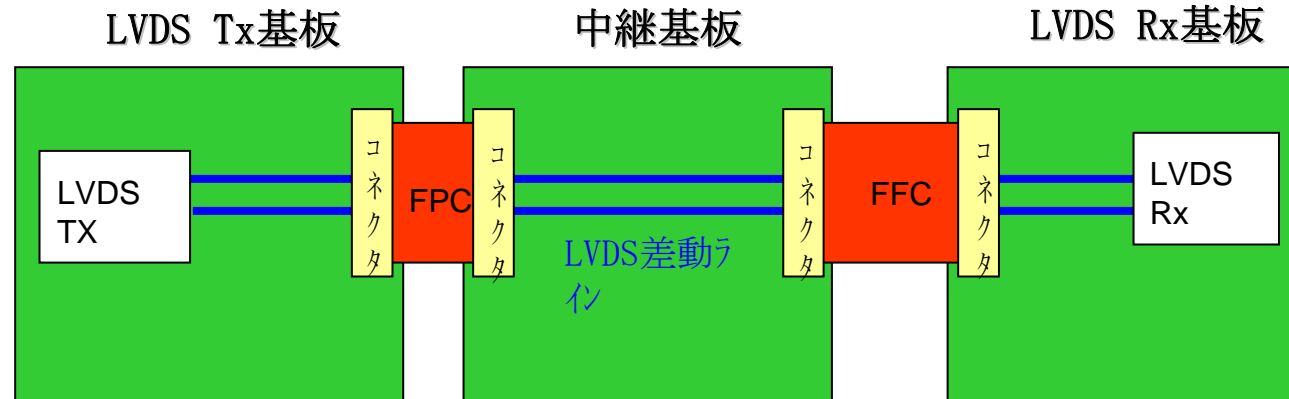
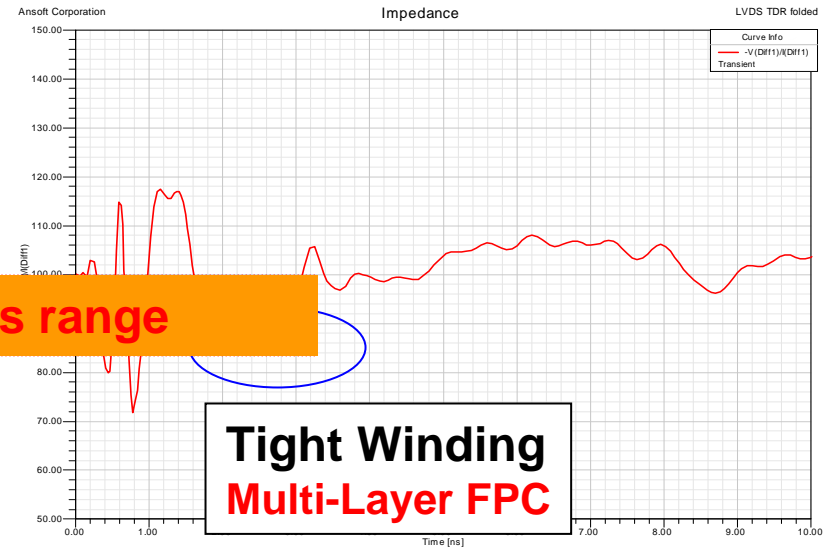
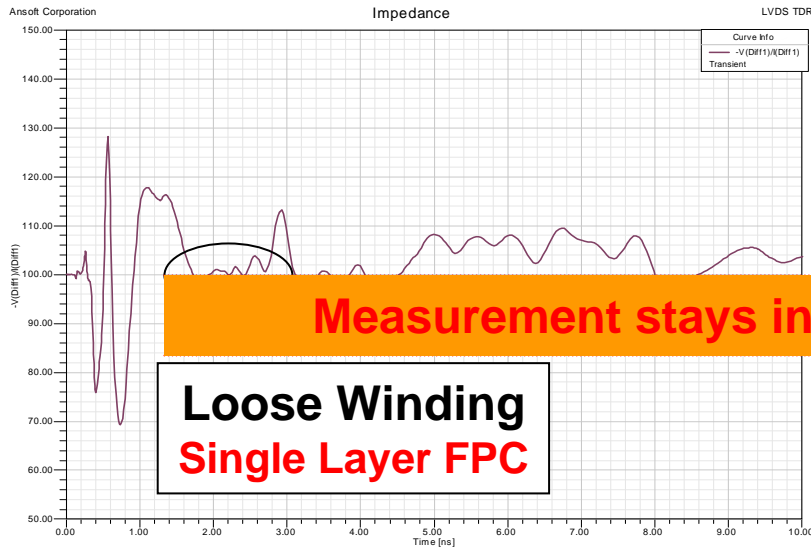


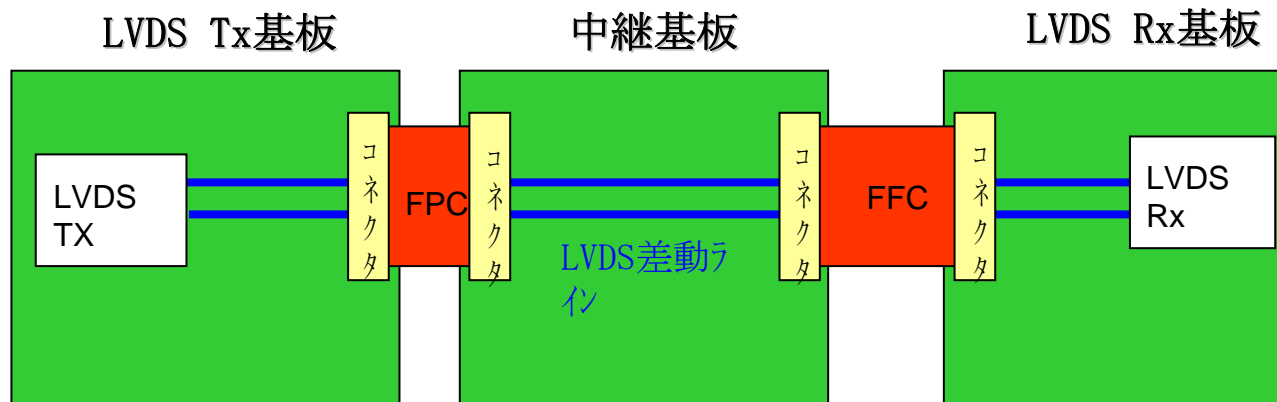
W-Element

W-Element

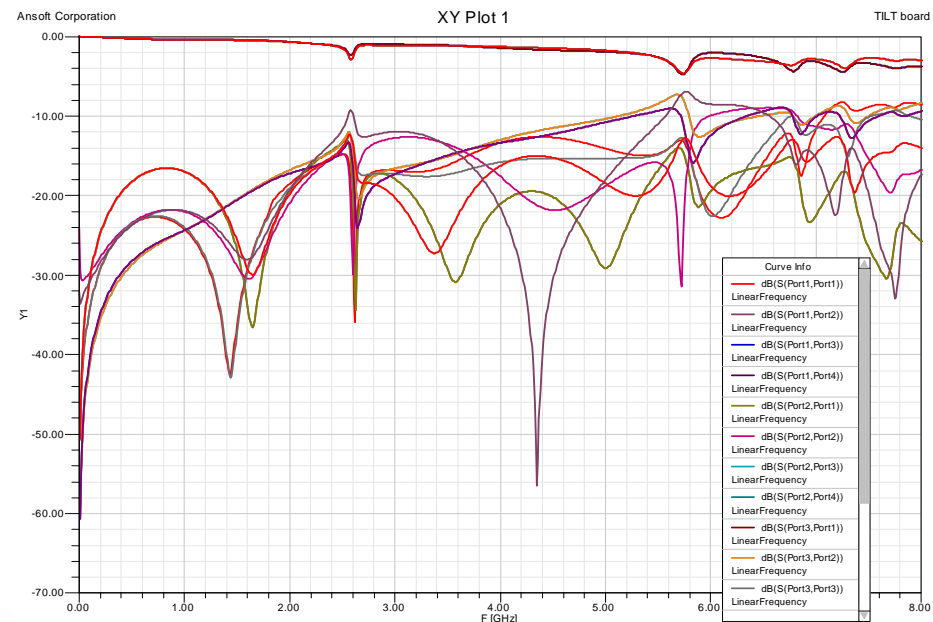
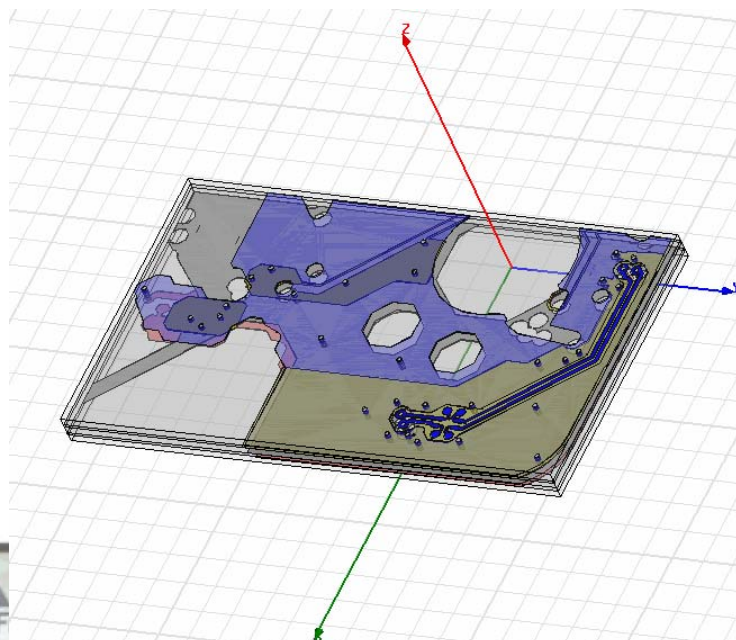


# FPC Straight and Bobbin effect





## TILT Board

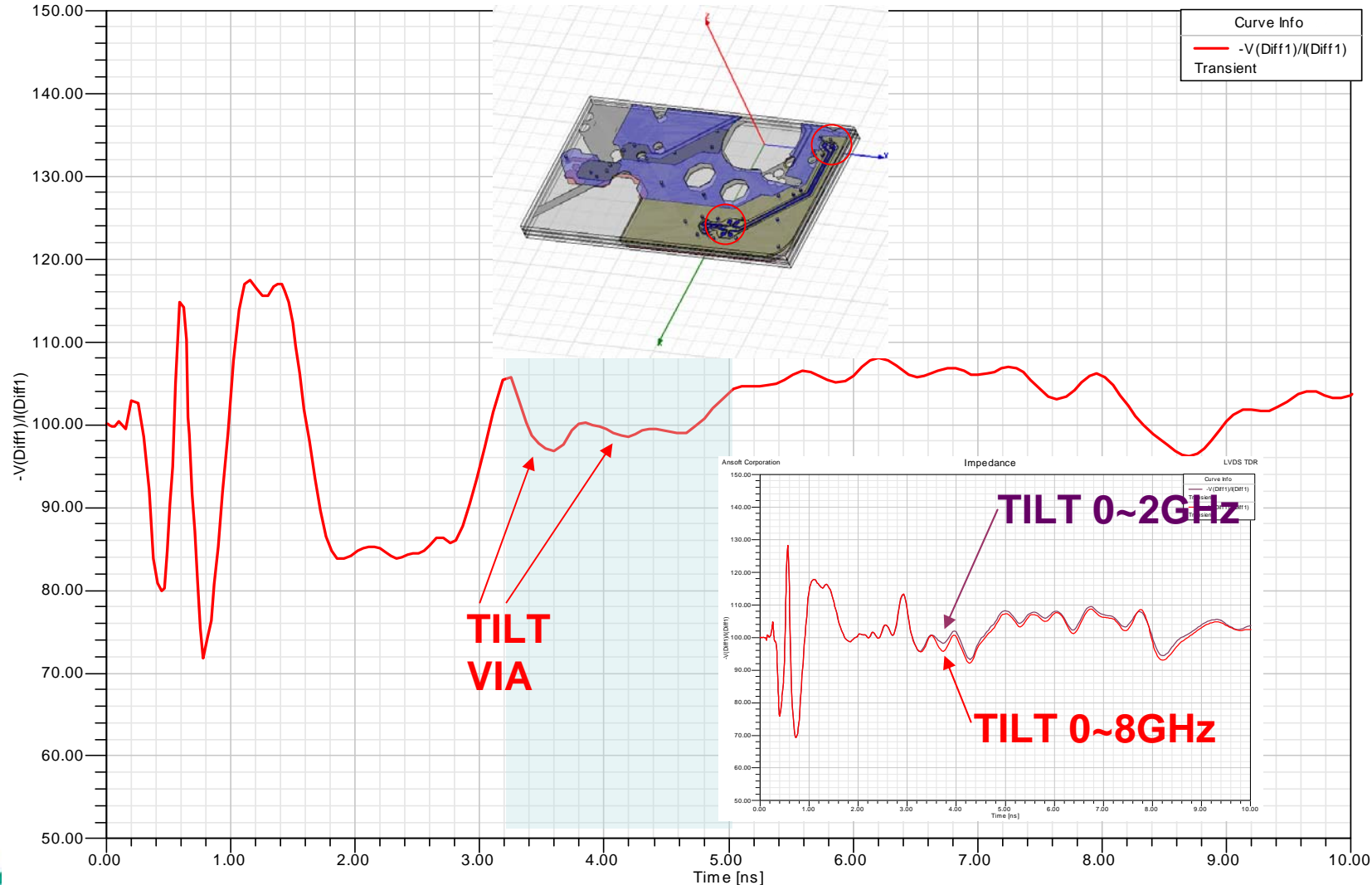


# TILT Board Time Domain

Ansoft Corporation

Impedance

LVDS TDR folded

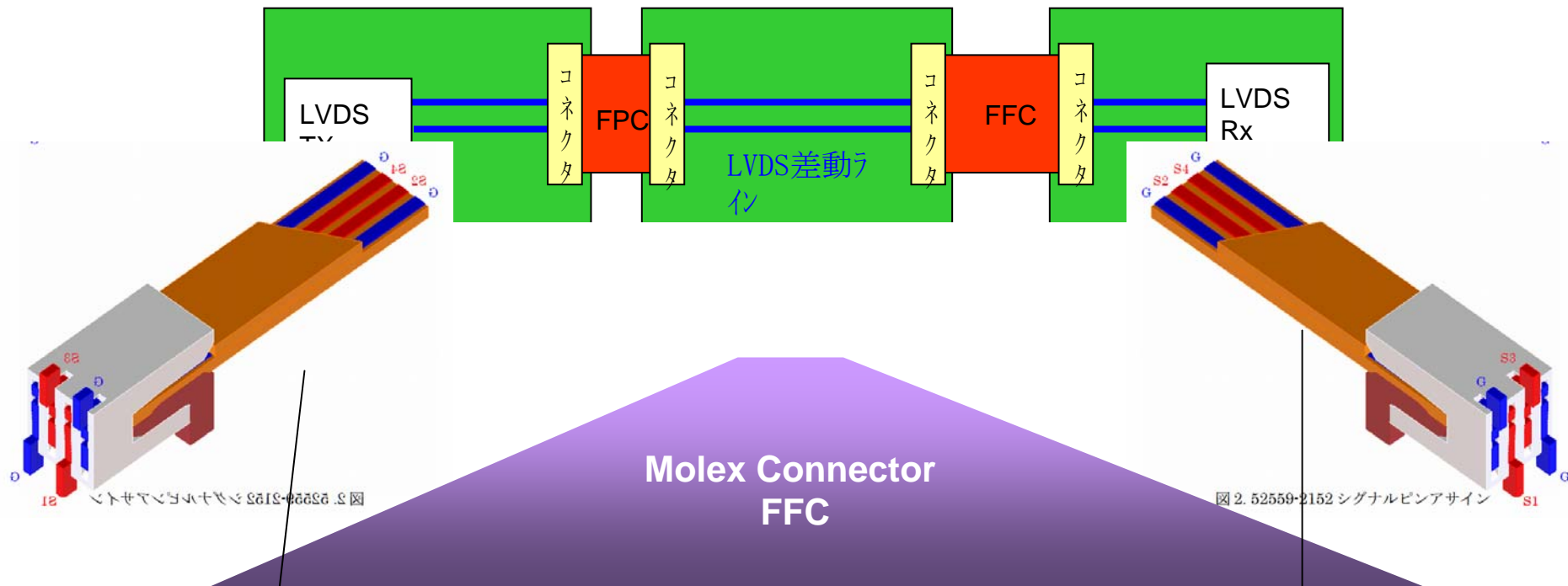




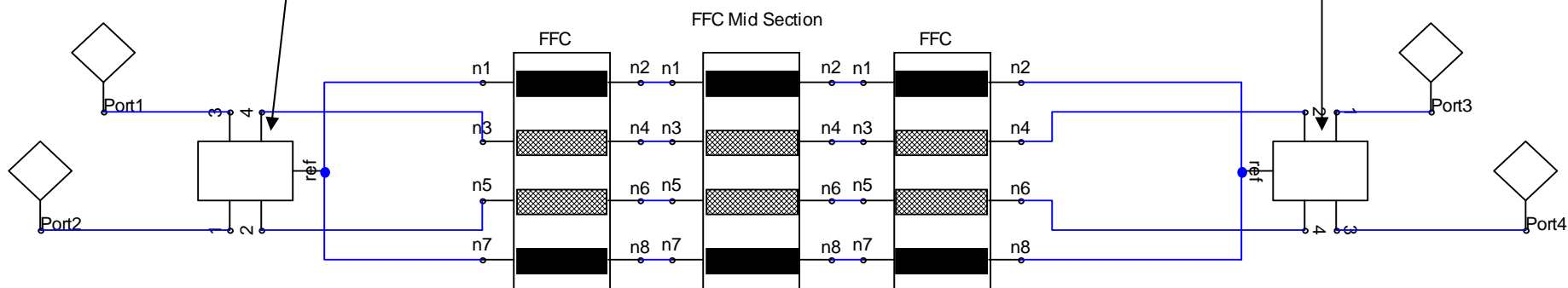
LVDS Tx基板

中継基板

LVDS Rx基板



Molex Connector  
FFC

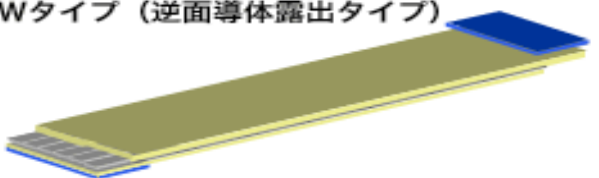


# FFC Geometry

Sタイプ (同一面導体露出タイプ)



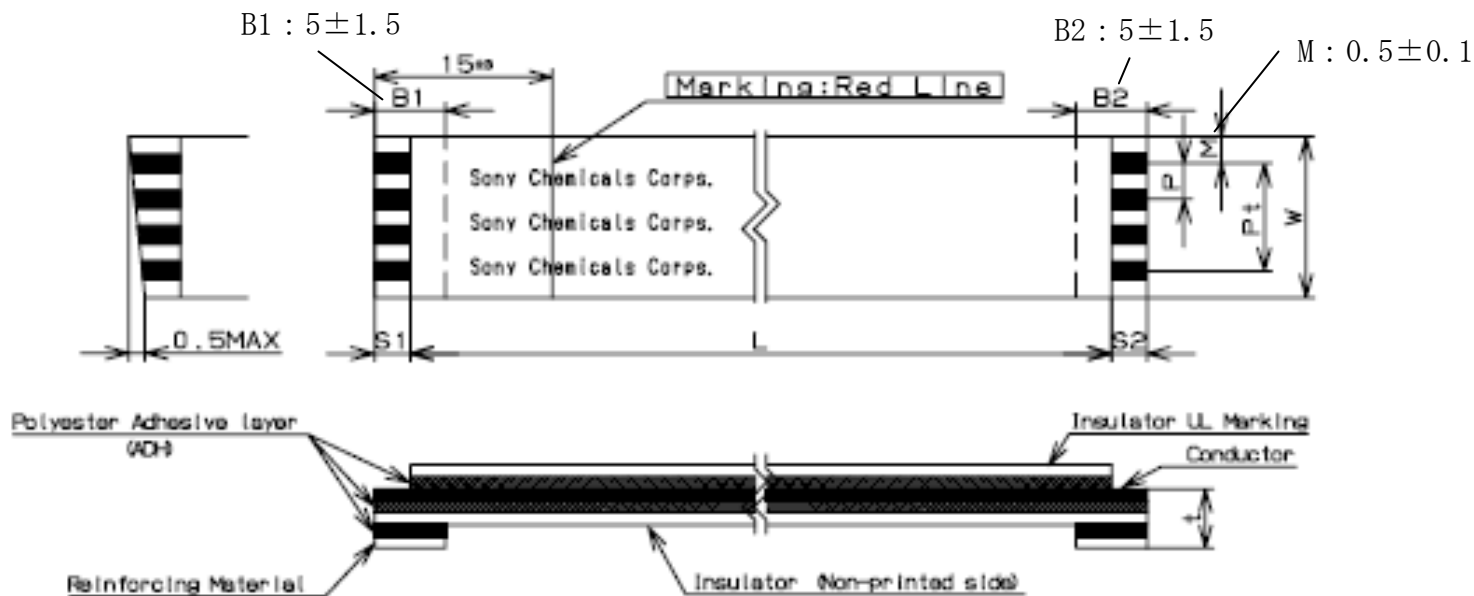
Wタイプ (逆面導体露出タイプ)



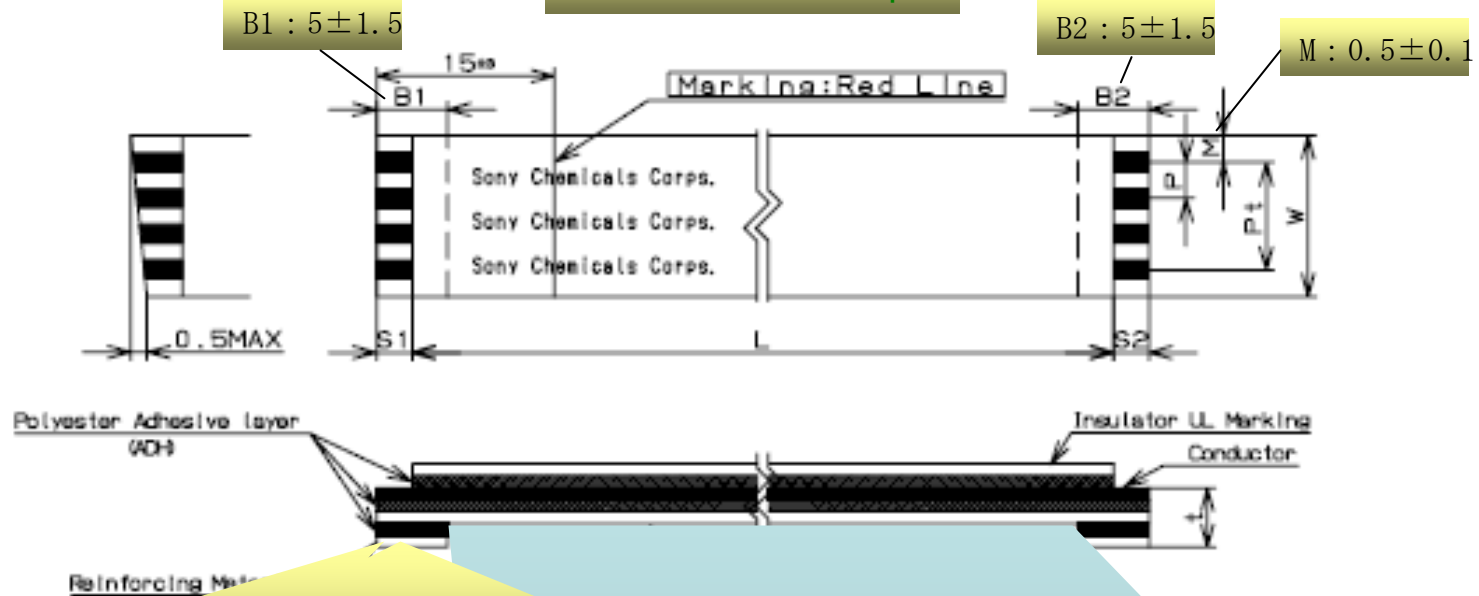
Bタイプ (片側導体露出タイプ)



Dタイプ (両側導体露出タイプ)



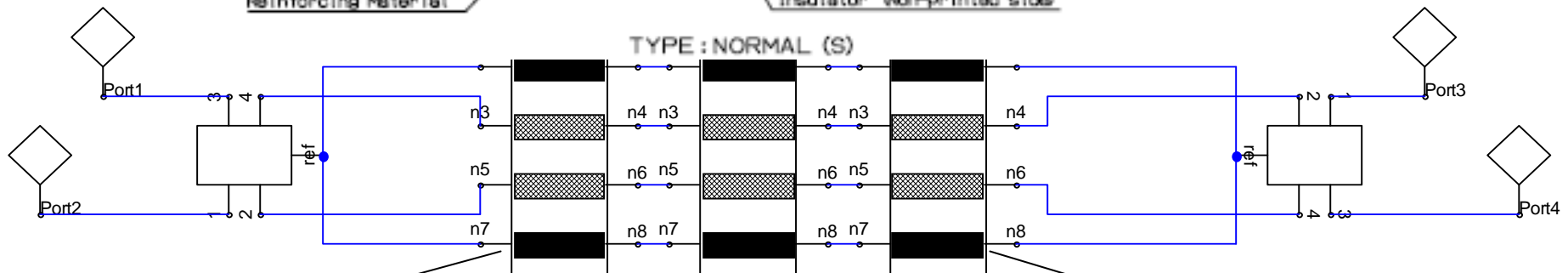
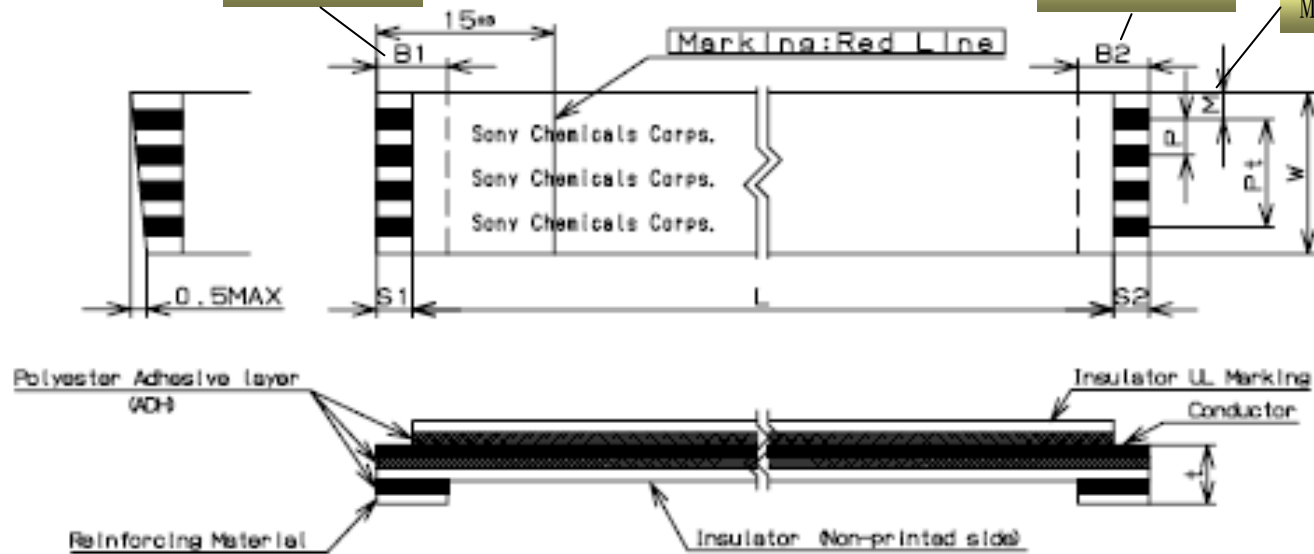
TYPE: NORMAL (S)



```
.layerstack FFC_edge
+ layer = (air, 'Air_thickness'),
+ layer = (Base, '188um'),
+ layer = (Polyester, '40um'),
+ layer = (Base, 'FFC_Base_Thickness'),
+ layer = (Polyester, 'FFC_polyester_Thickness+FFC_Conductor_Thickness'),
+ layer = (air, 'Air_thickness+FFC_polyester_Thickness+FFC_Base_Thickness')
```

```
.layerstack FFC_mid
+ layer = (air, 'Air_thickness+188um+40um'),
+ layer = (Base, 'FFC_Base_Thickness'),
+ layer = (Polyester, '2*FFC_polyester_Thickness+FFC_Conductor_Thickness'),
+ layer = (Base, 'FFC_Base_Thickness'),
+ layer = (air, 'Air_thickness')
```



B1 :  $5 \pm 1.5$ B2 :  $5 \pm 1.5$ M :  $0.5 \pm 0.1$ 

Name	Value	Unit	Evaluated Value	Description	Callback	Override
ModelName	x					
P	5	mm	5mm			
W1	300	um	300um			
W2	300	um	300um			
W3	300	um	300um			
W4	300	um	300um			
S12	200	um	200um			
S23	200	um	200um			
S34	200	um	200um			

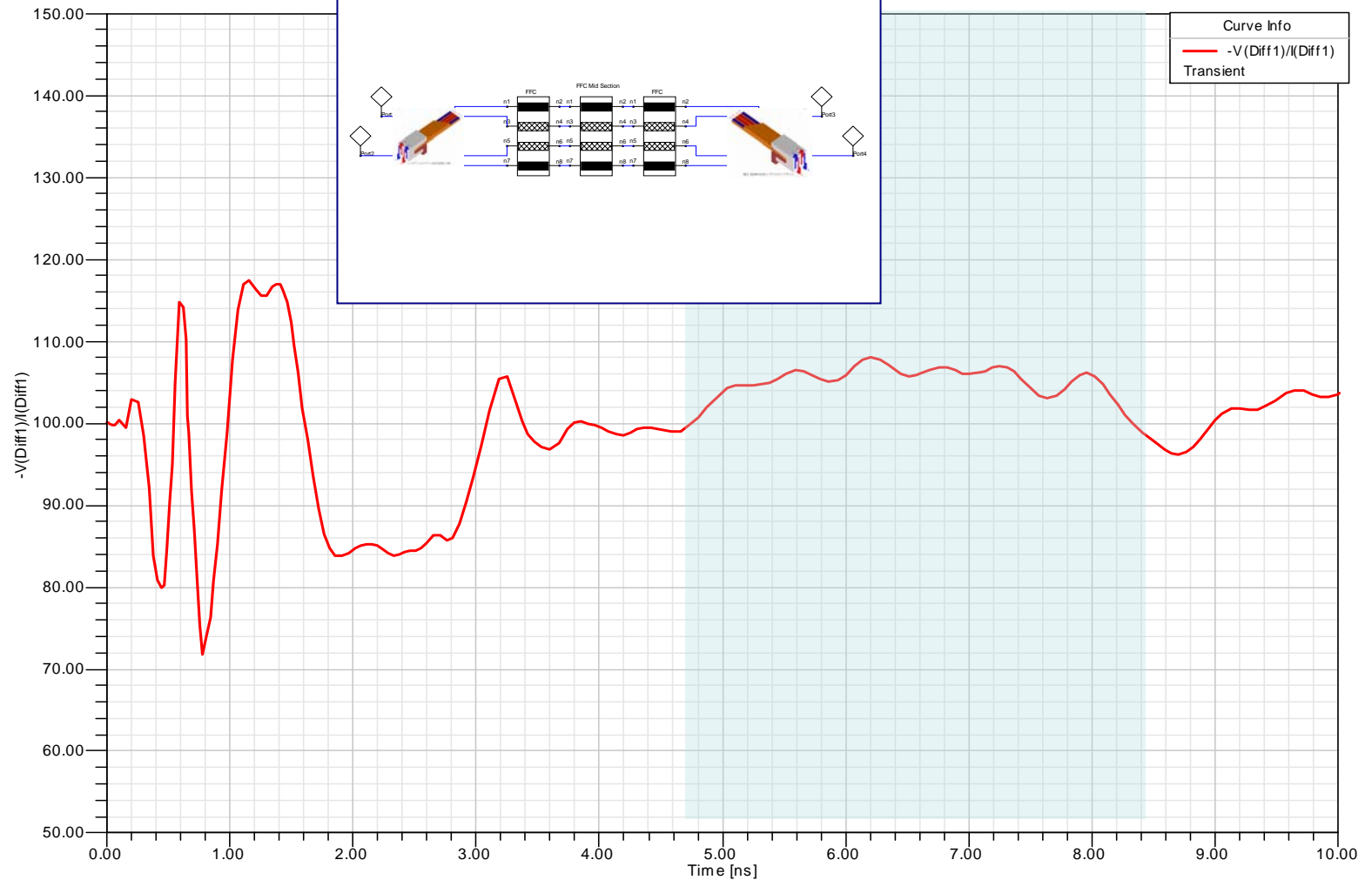
Name	Value	Unit	Evaluated Value	Description	Callback	Override
ModelName	x					
P	5	mm	5mm			
W1	300	um	300um			
W2	300	um	300um			
W3	300	um	300um			
W4	300	um	300um			
S12	200	um	200um			
S23	200	um	200um			

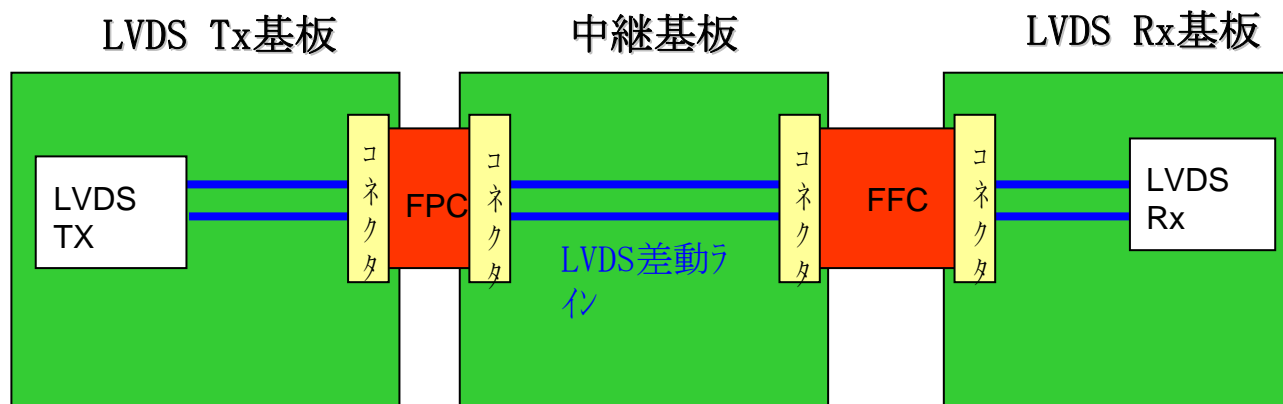
Name	Value	Unit	Evaluated Value	Description	Callback	Override
ModelName	x					
P	319	mm	319mm			
W1	300	um	300um			
W2	300	um	300um			
W3	300	um	300um			
W4	300	um	300um			
S12	200	um	200um			

# FFC Time Domain

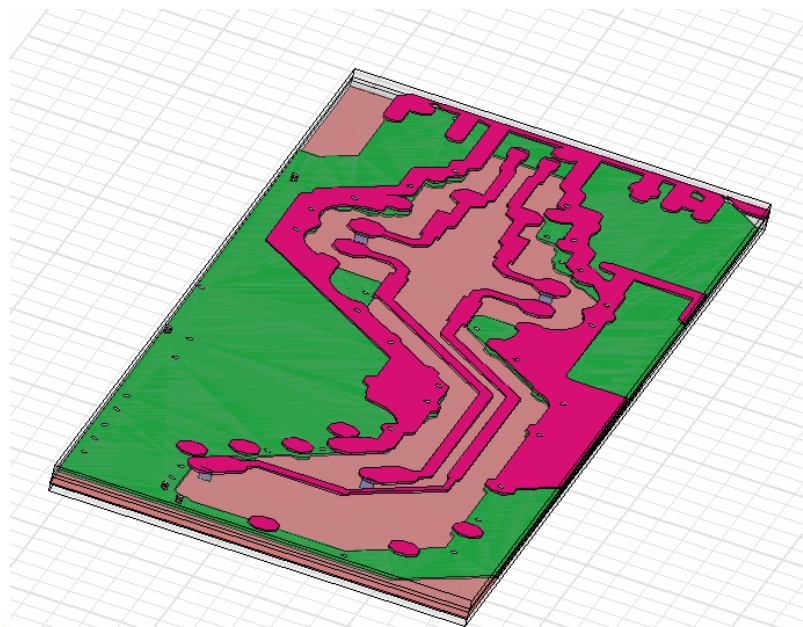
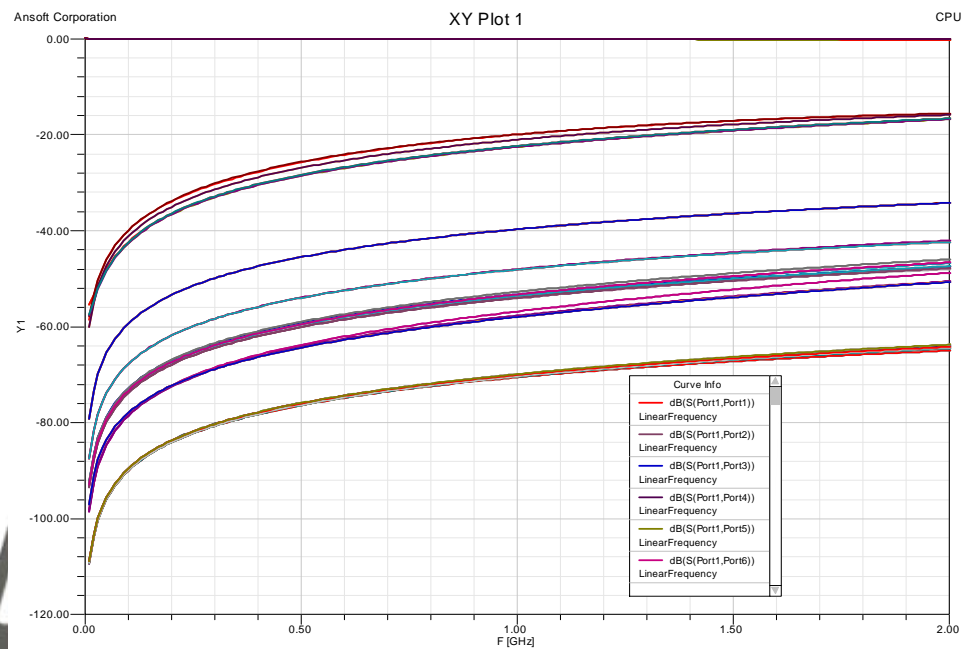
Ansoft Corporation

LVDS TDR folded





## LVDS Rx Board

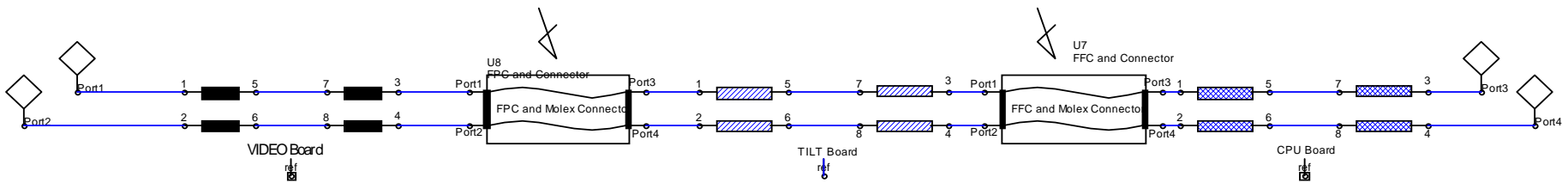




# LVDS System Review

FPC and Molex Connectors

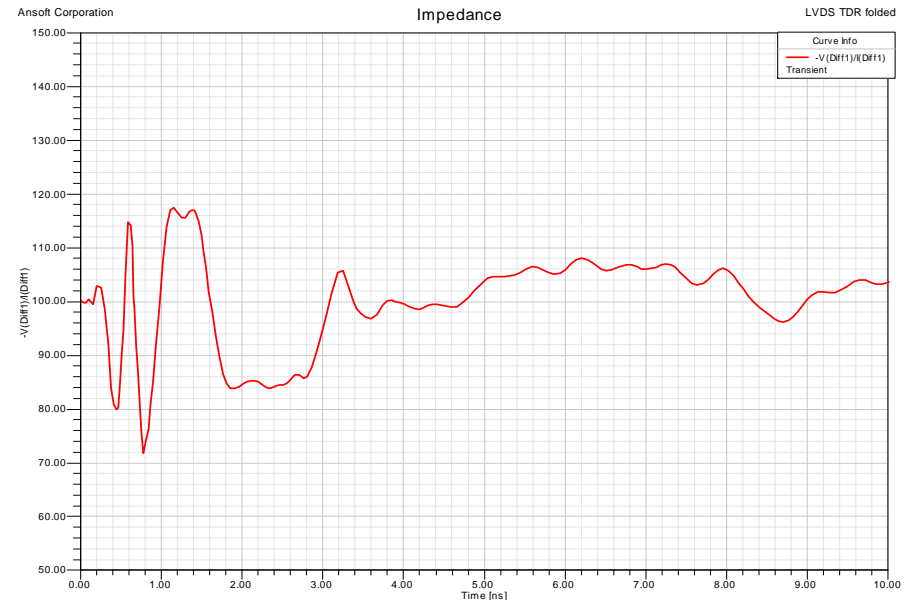
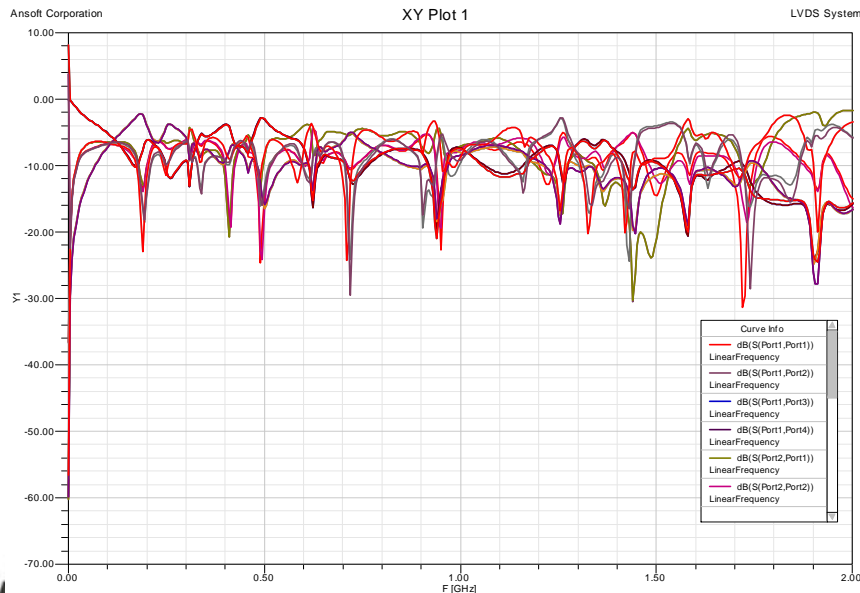
FFC and Molex Connectors



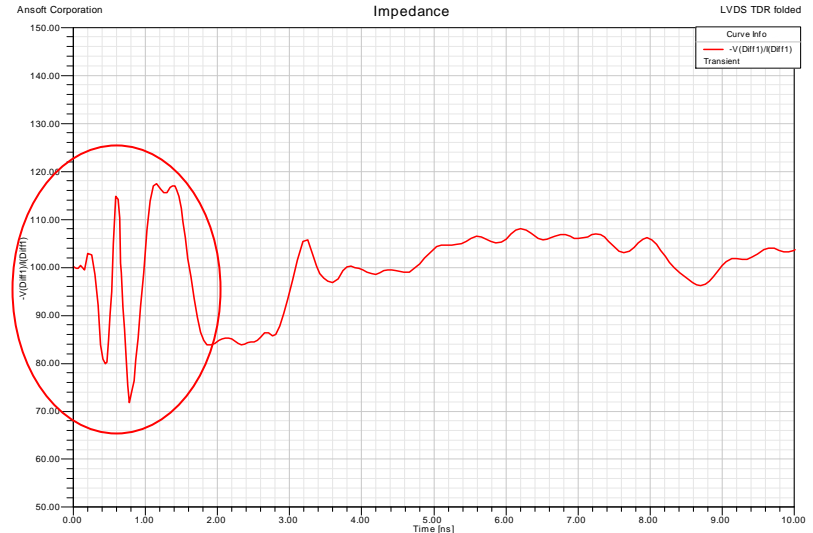
LVDS Tx基板

中継基板

LVDS Rx基板



# Improving the Design

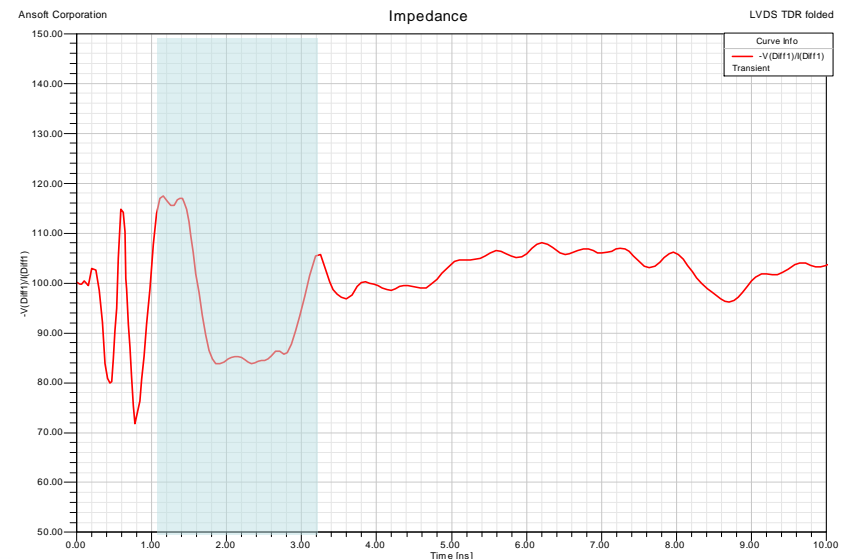
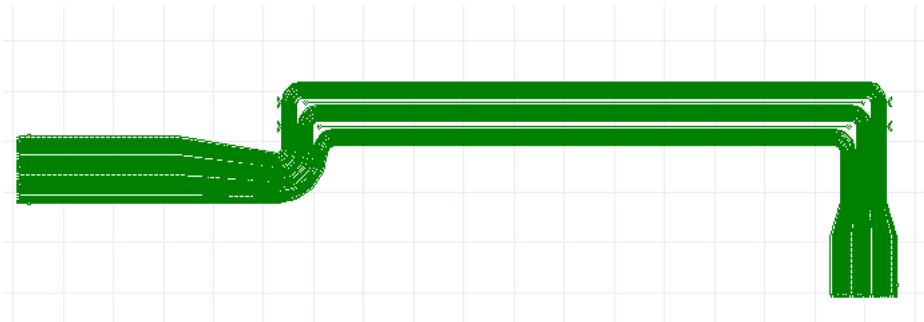


- VIDEO Board
- FPC Board

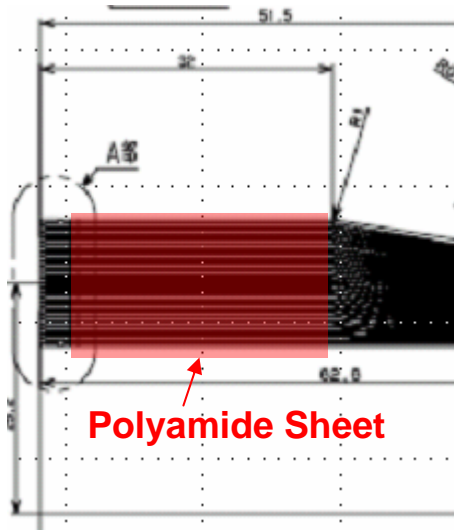
- Impedance matching through the **FPC** line
- Impedance matching and **Skew Reduction** in **VIDEO Board**
  - **EYE Design and Reduction of Differential to Common Mode**



# Improving Impedance Matching on the FPC



# Matching FPC



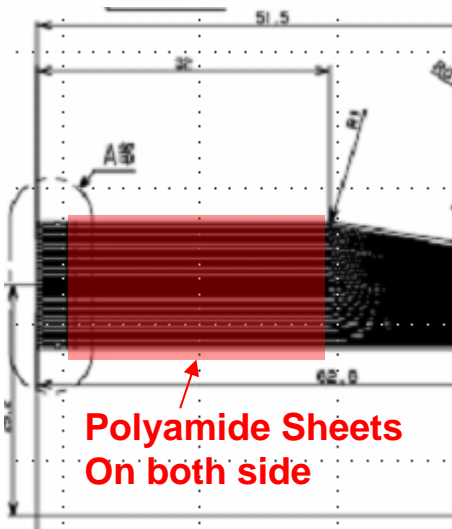
By placing Polyamide sheet on top of FPC, Electromagnetic fields are captured in the vicinity of the Differential Line. Hence the Capacitor increase resulting to decrease the Characteristic impedances







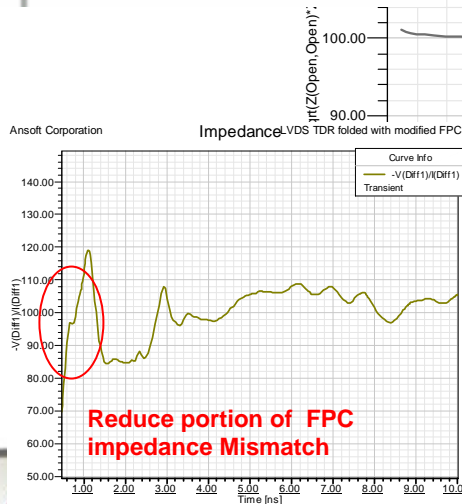
# Matching FPC Impedance



XY Plot 1

FPC Improve

75um Polyamide sheets on both side of FPC

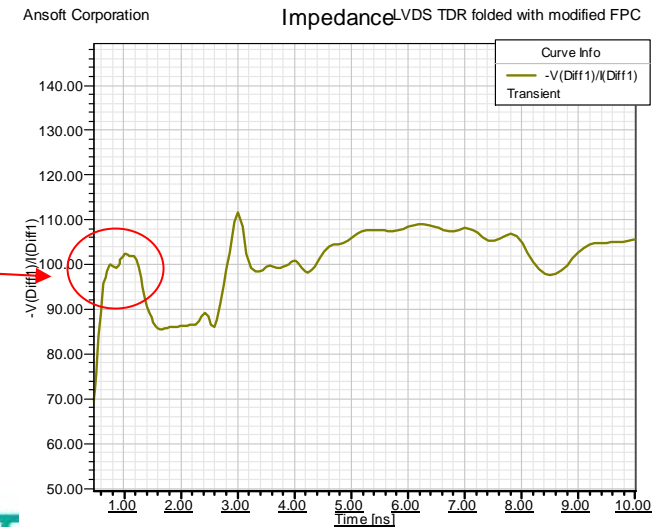
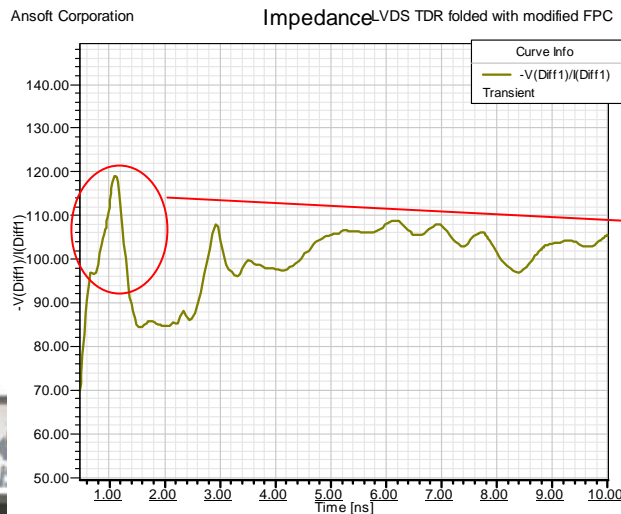
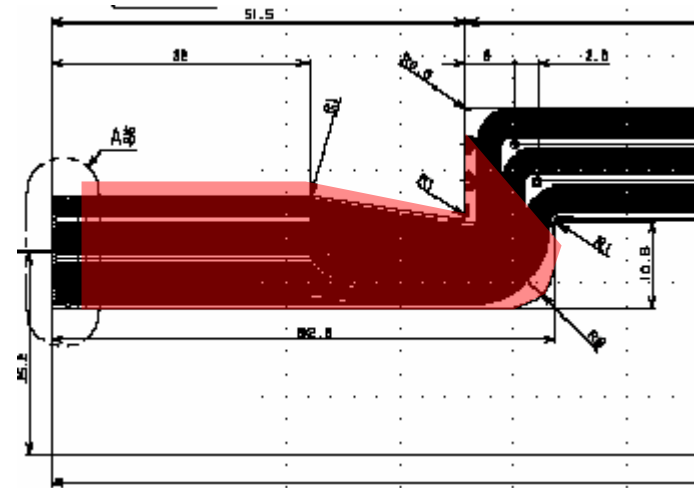
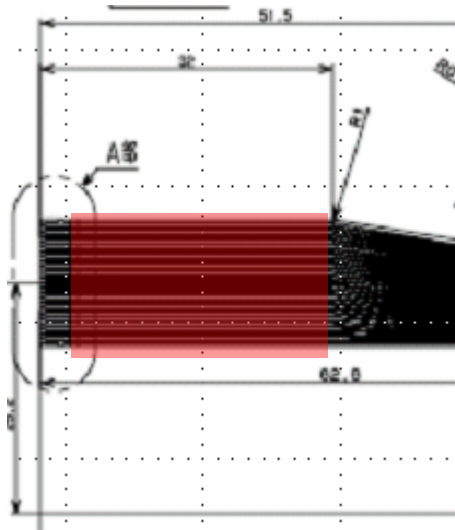


```

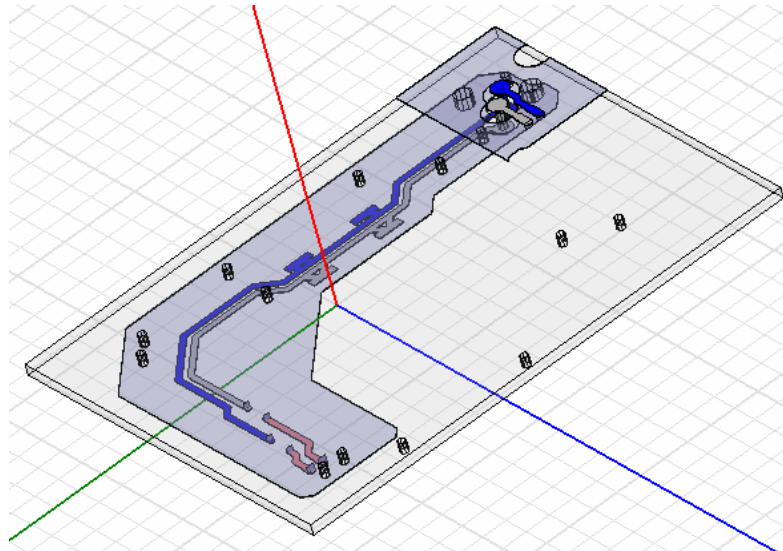
=====
.param FPC_Base=25.4um
.param FPC_Conductor=35um
.param Air_thickness=800um
.param FPC_Thickness='Air_thickness+3*FPC_Base'
.param FPC_Thickness_stacked='Air_thickness+(2*FPC_Base+FPC_Conductor)+FPC_Base'
=====
.layerstack FPCBoard
+ layer = (air, 'Air_thickness'),
+ layer = (Polyamide, '6*FPC_Base+FPC_Conductor'),
+ layer = (air, 'Air_thickness')
    
```



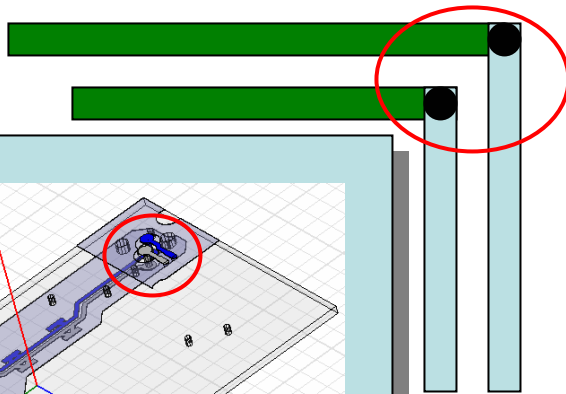
# Covering with Polyamide Sheets



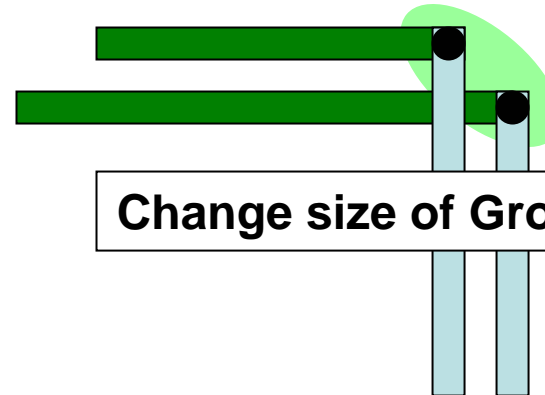
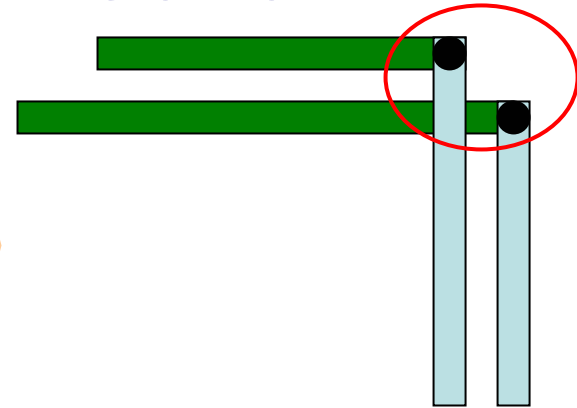
# Improving Impedance Matching and Skew on the LVDS Tx board



# Skew and Impedance Matching on LVDS Tx Board

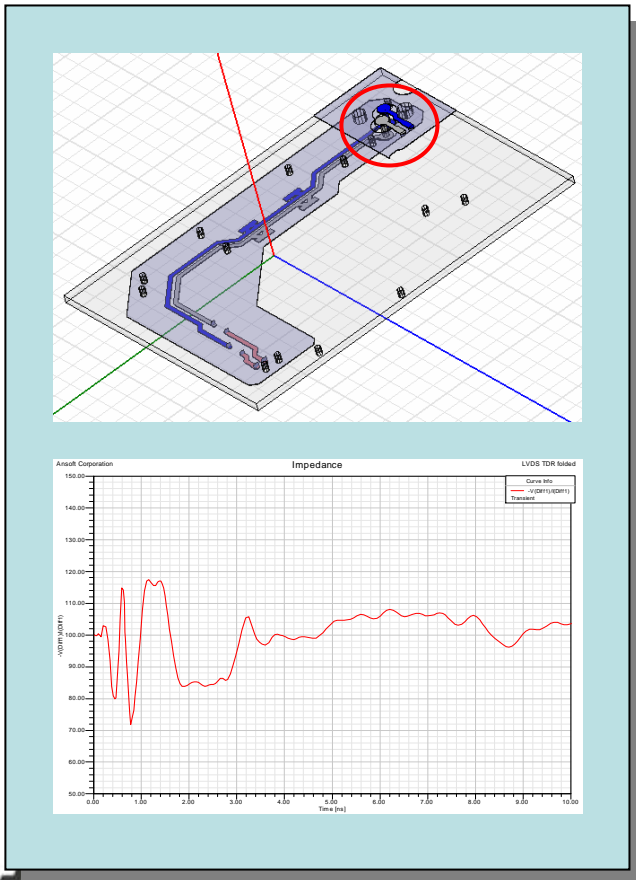


Skew  
Matching  
Strategy



Change size of Ground Hall

Impedance Matching Strategy



ANSOFT

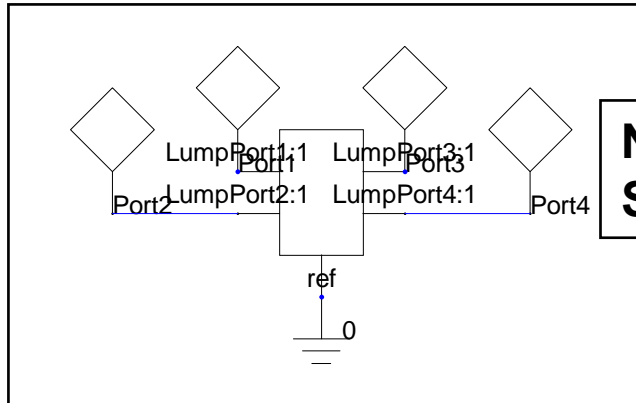


**FIRST-PASS SYSTEM SUCCESS**

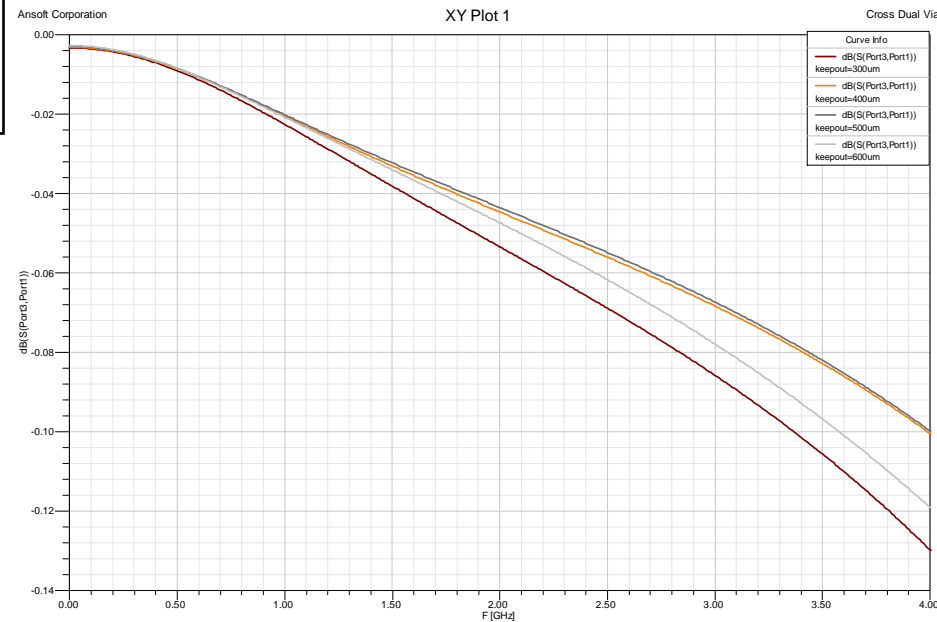
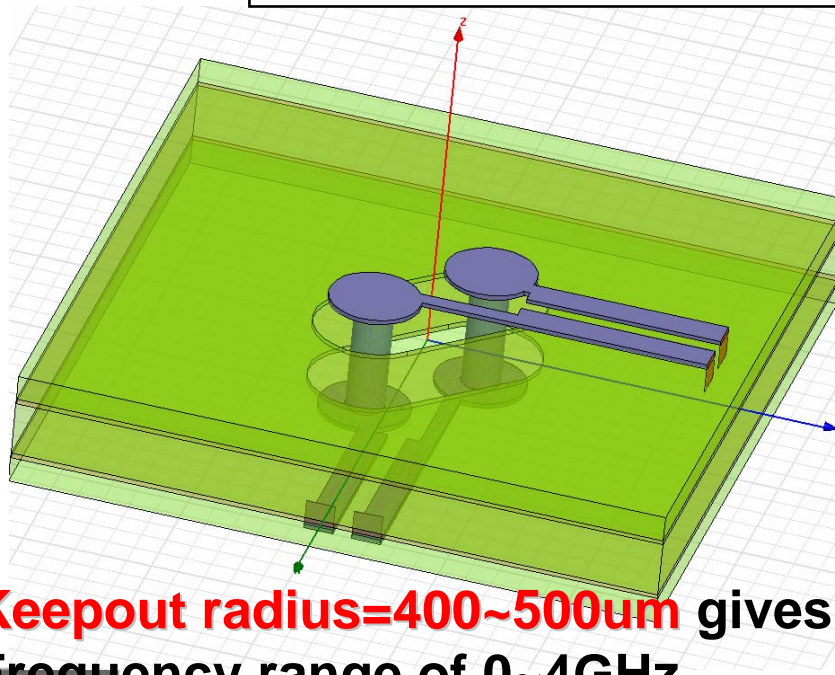
APPLICATION WORKSHOPS FOR HIGH-PERFORMANCE ELECTRONIC DESIGN



# Crossed Dual Via Model in HFSS



**Nexxim Dynamic Link to HFSS**  
**Sweep on the parameters on the HFSS**

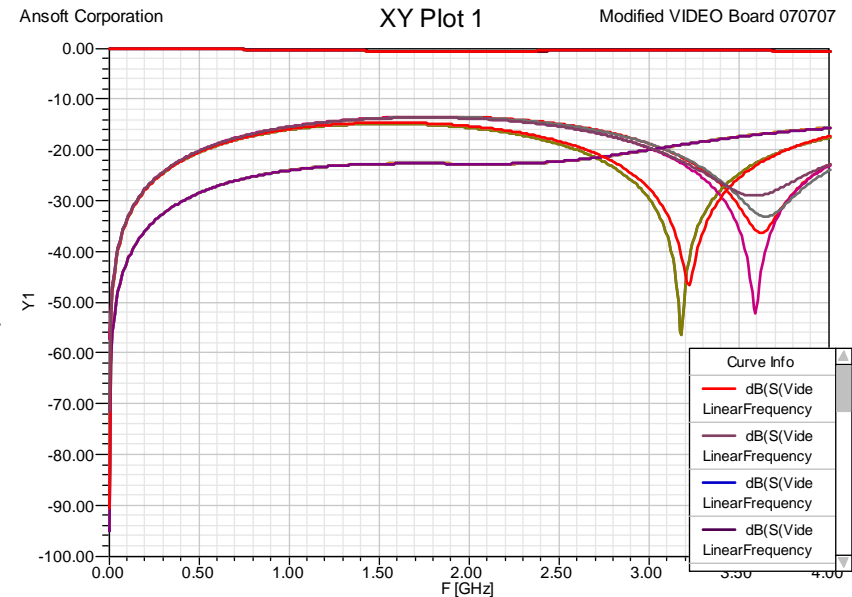
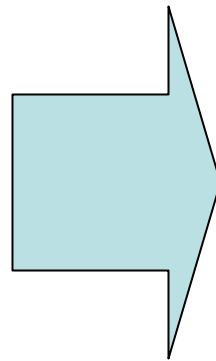
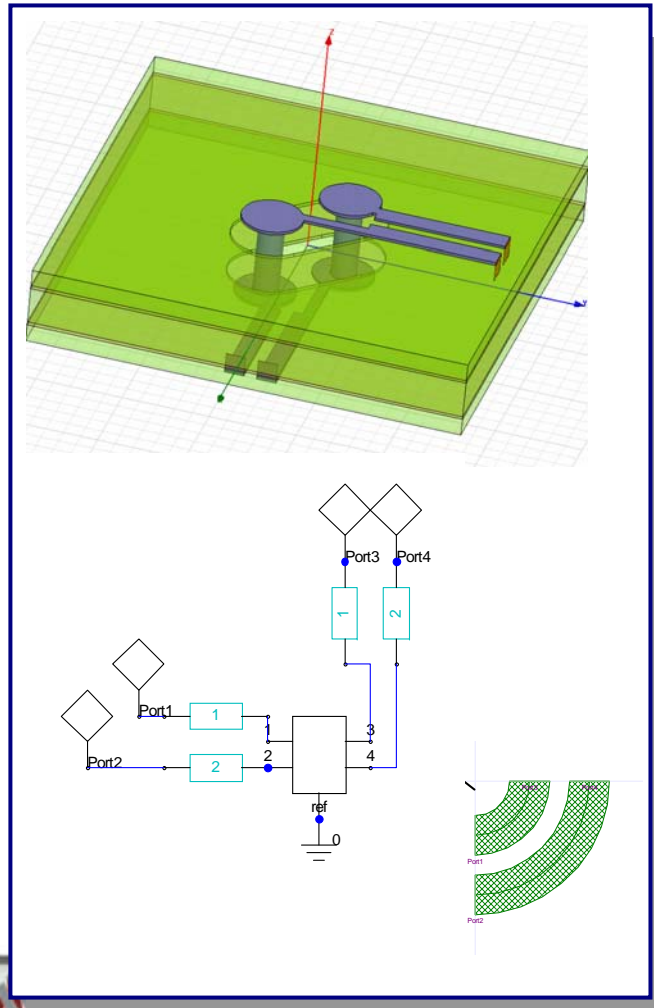


**Keepout radius=400~500um** gives the maximum transfer through the  
**Frequency range of 0~4GHz**

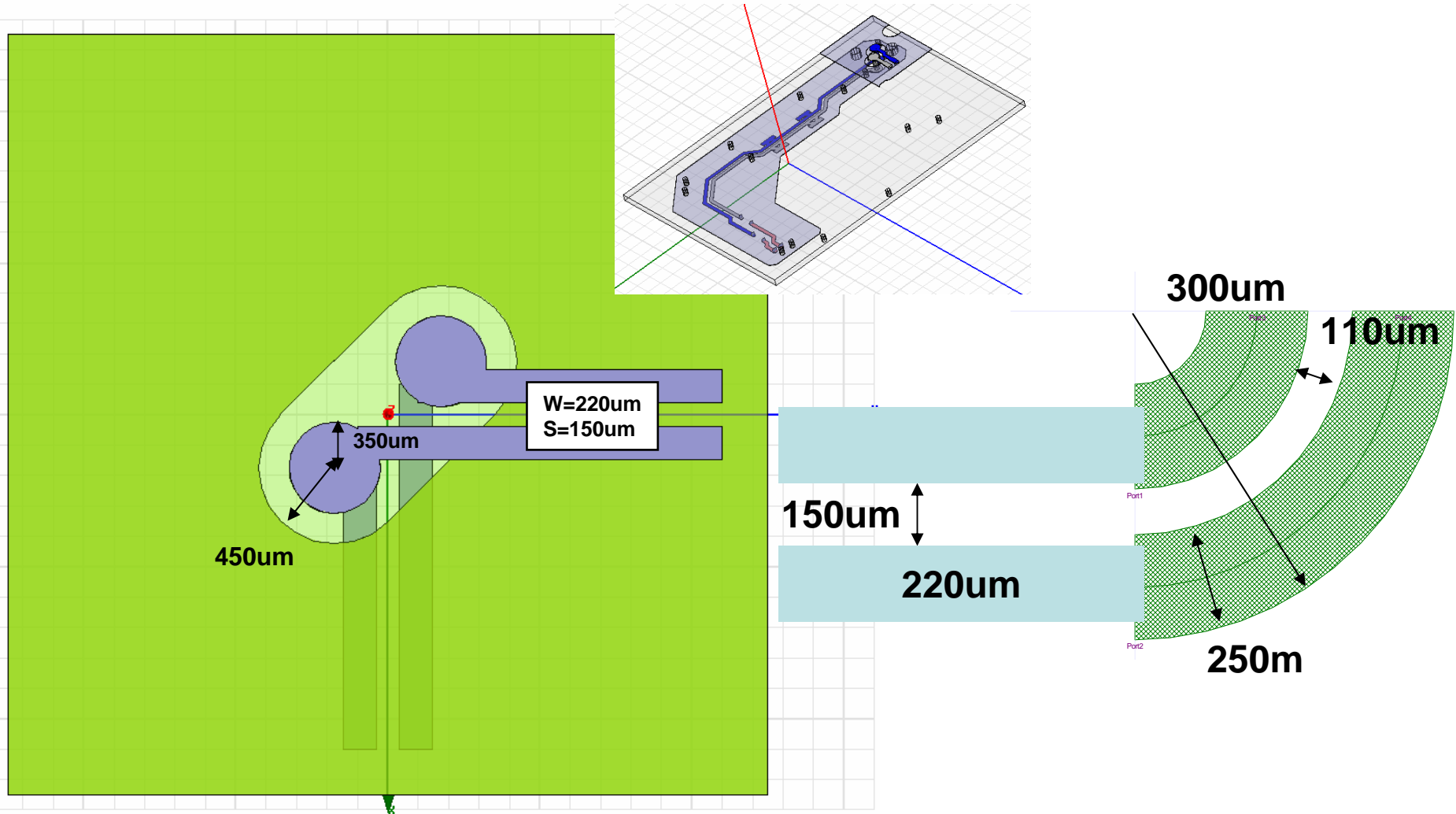




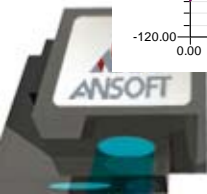
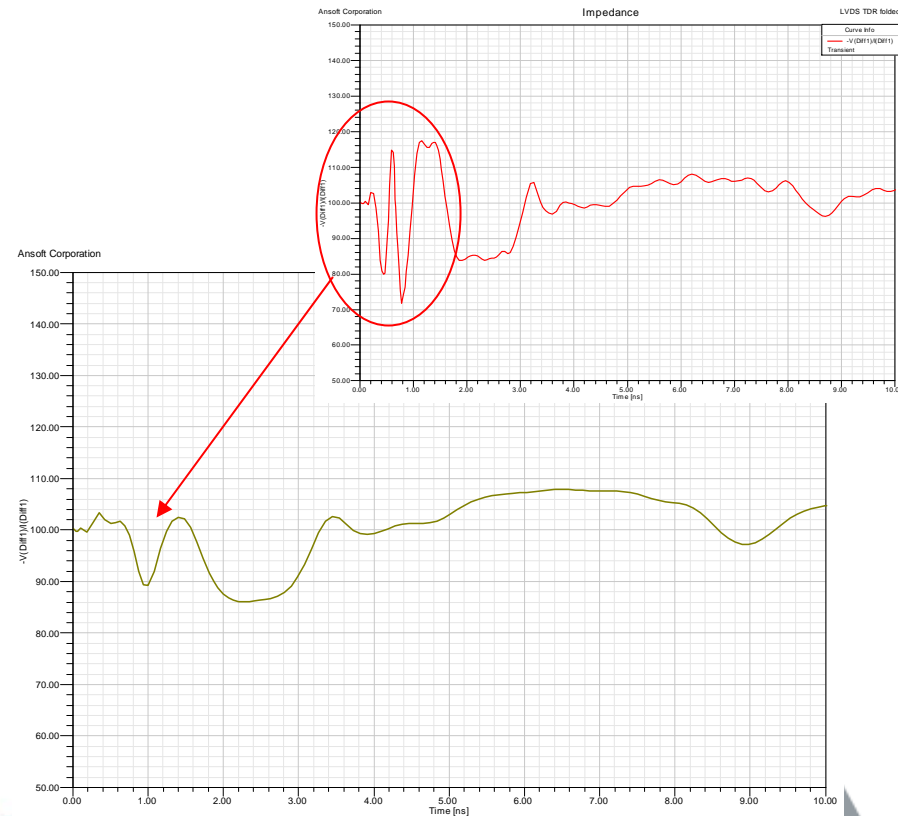
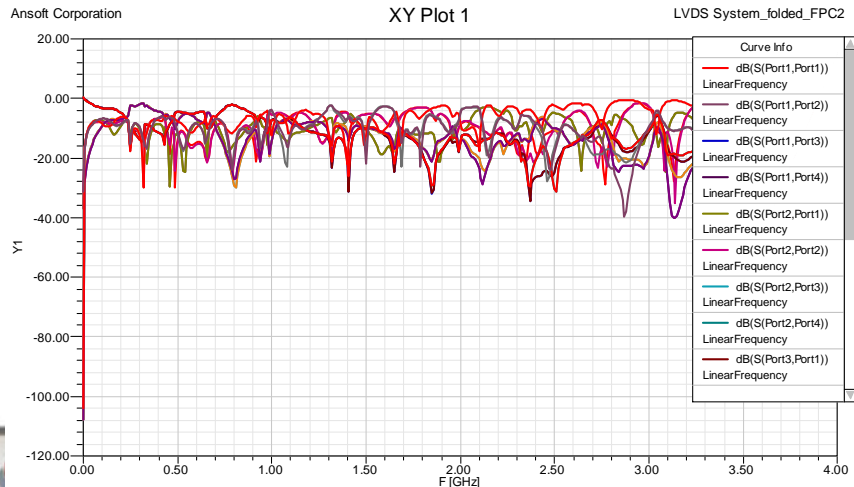
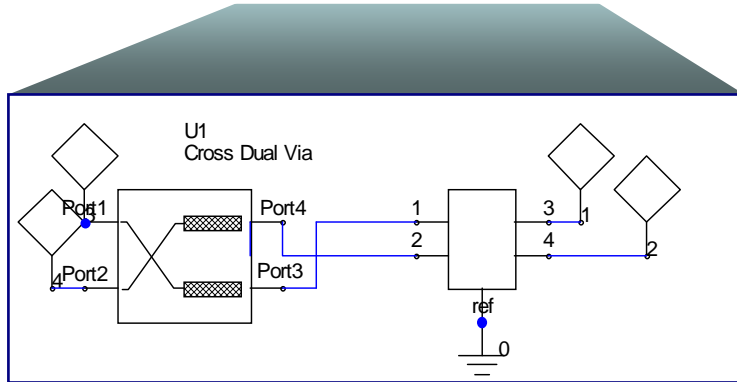
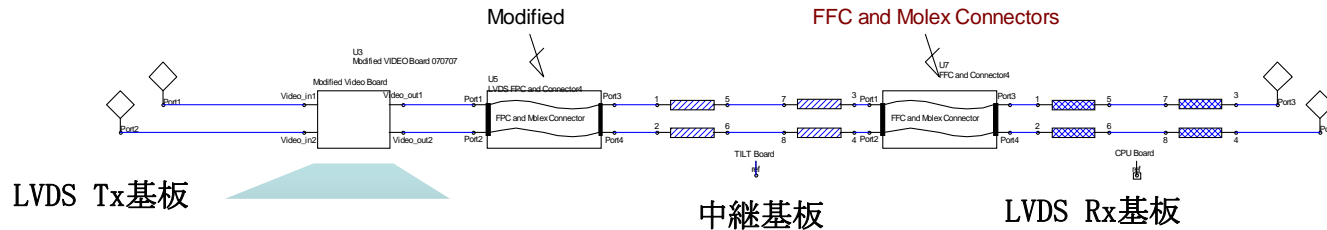
# Layout Design using PlanarEM in Ansoft Designer 4.0



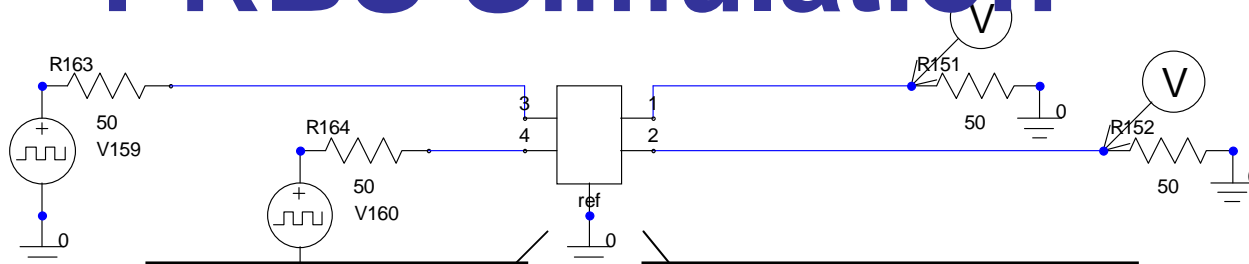
# Final Design Modification



# Modified Total System

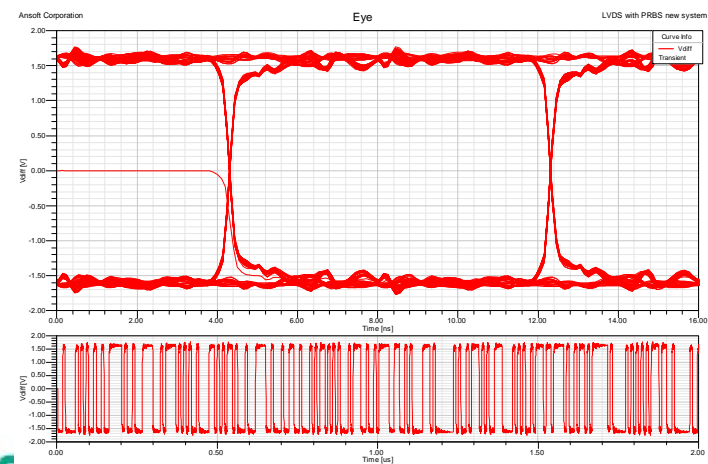
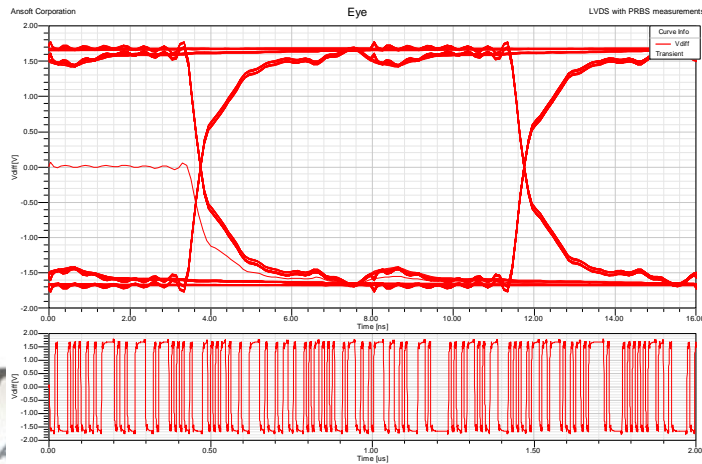
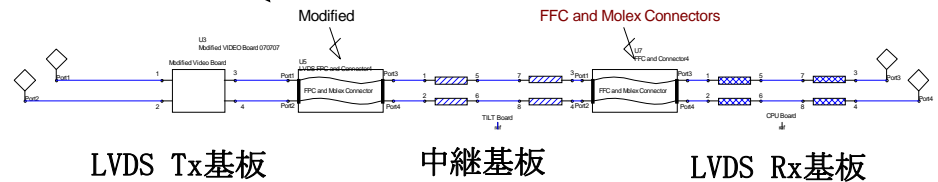
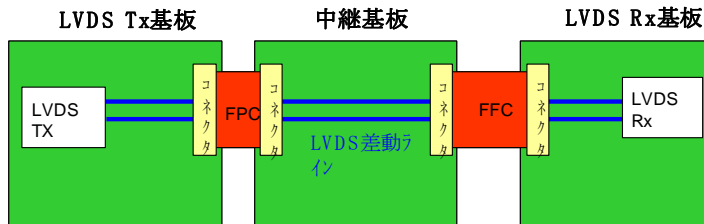


# PRBS Simulation

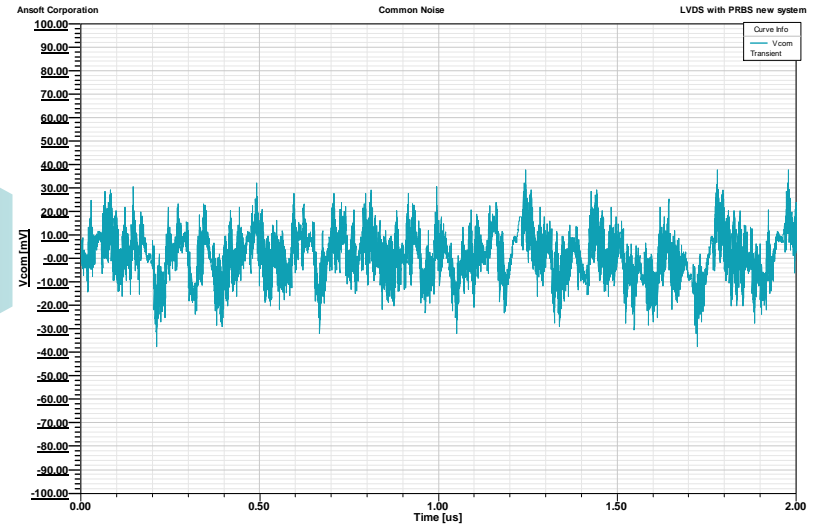
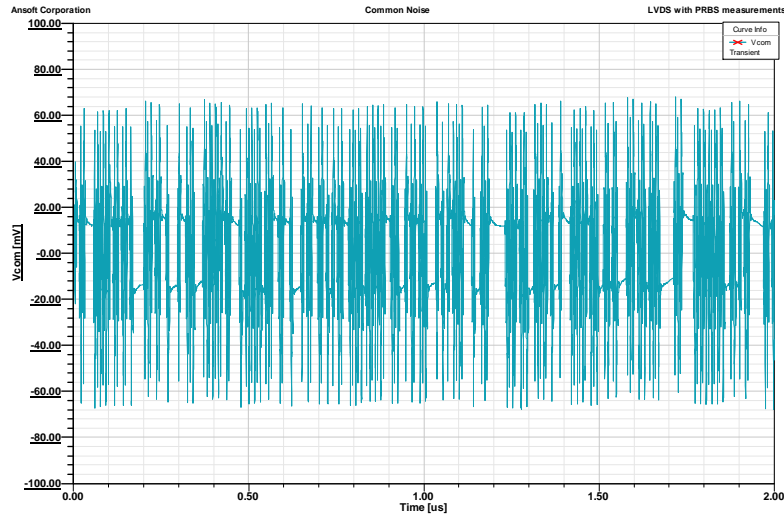


**Measurements Simulation**

**Modified Video/FPC**

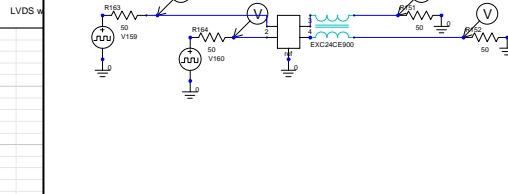
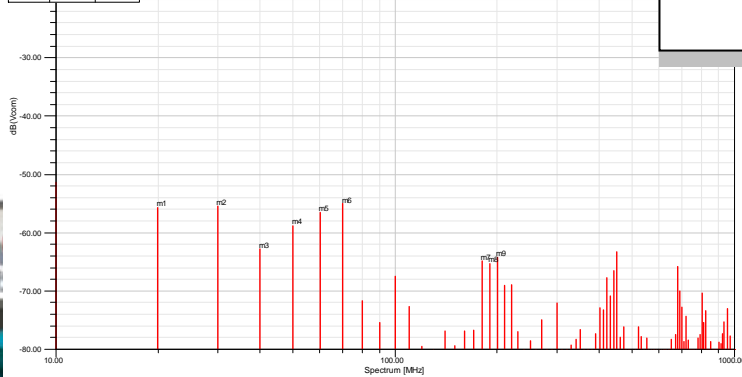


# Output Common Noise

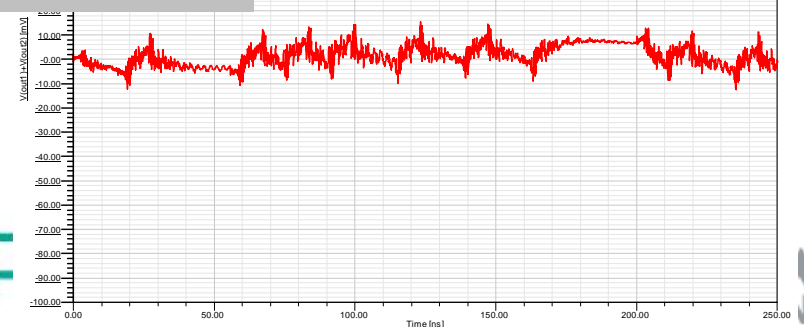


Name	X	Y
m1	20.0000	-55.6880
m2	30.0000	-55.3825
m3	40.0000	-62.7354
m4	50.0000	-58.8138
m5	60.0000	-56.4034
m6	70.0000	-54.9845
m7	180.0000	-64.7677
m8	190.0000	-65.2964
m9	200.0000	-64.2190

XY Plot 1

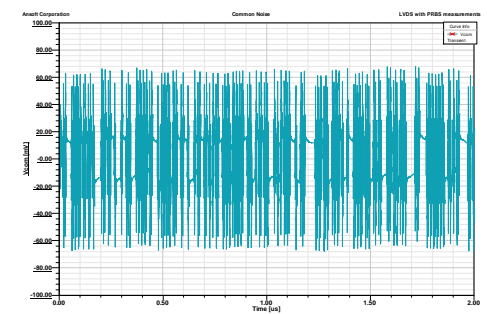
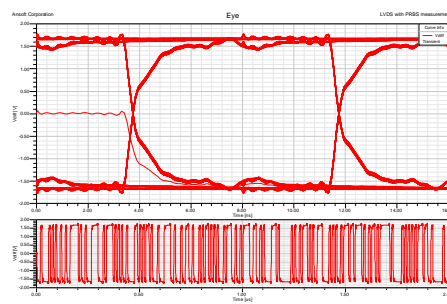
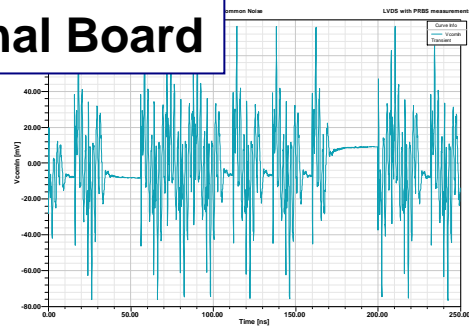


ith CMNF

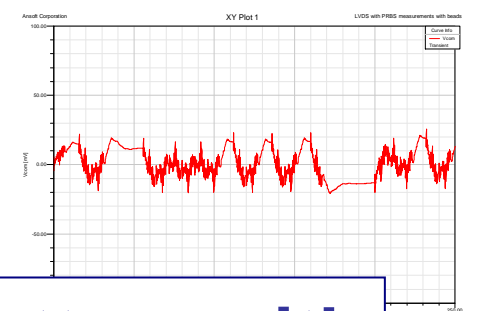
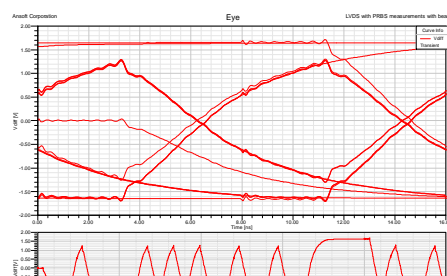
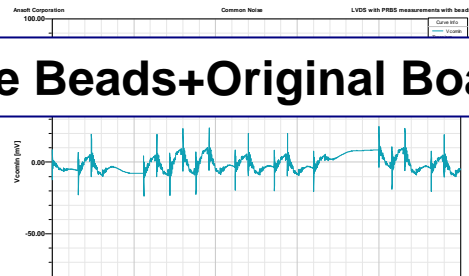




## Original Board

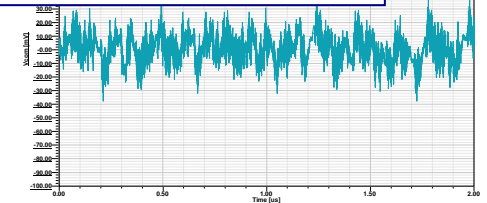
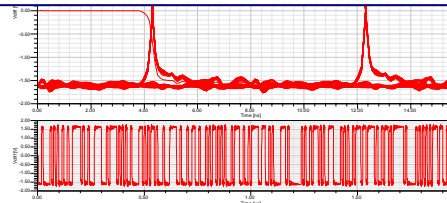
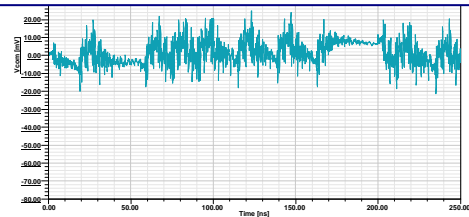


## Ferrite Beads+Original Board

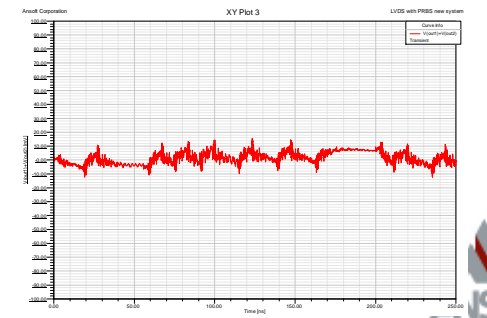
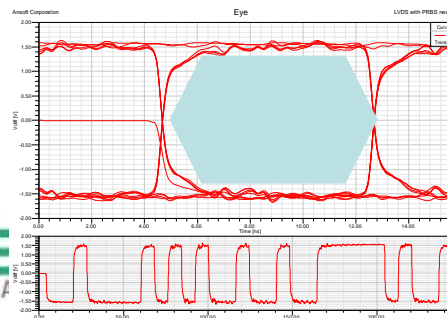
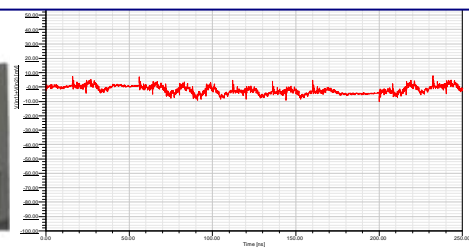


Can achieve Much Quality EYE pattern with Lower Common Mode Degeneration!!

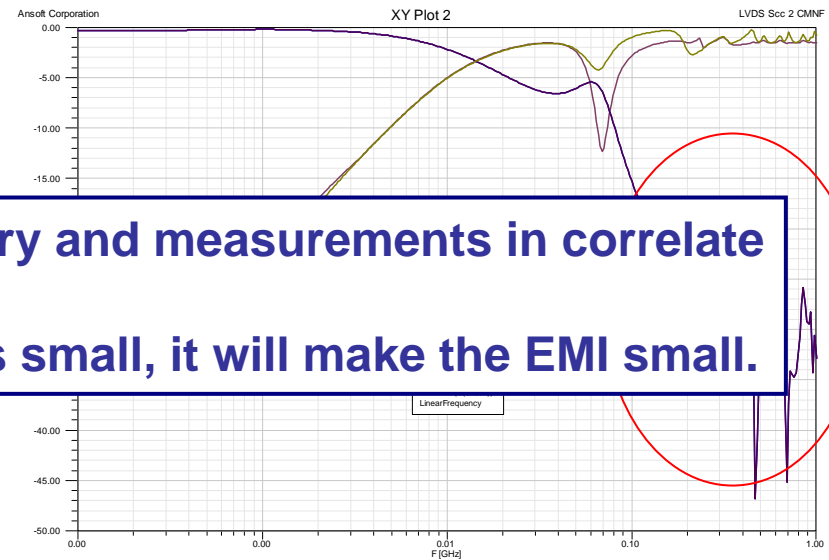
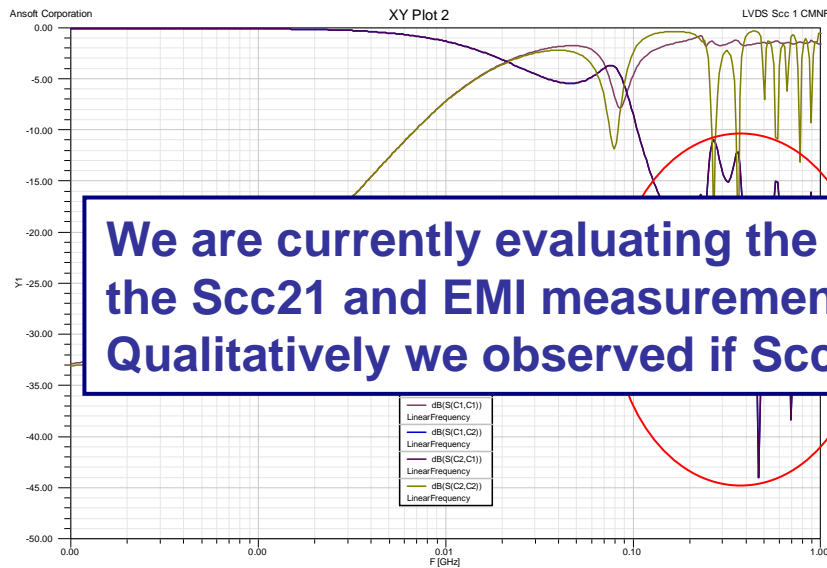
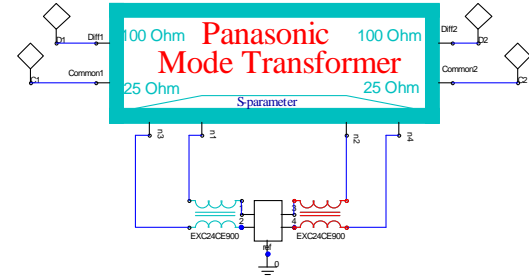
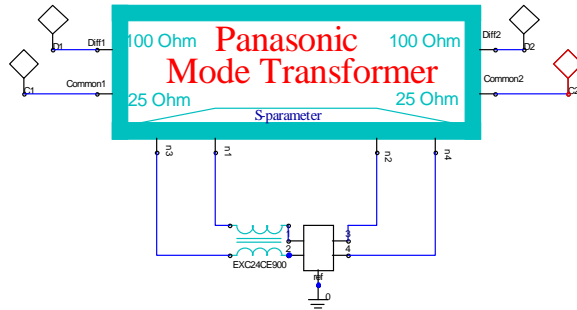
Mod



## CMNF+Modified FPC/VIDEO



# Using Scc21 and EMI?

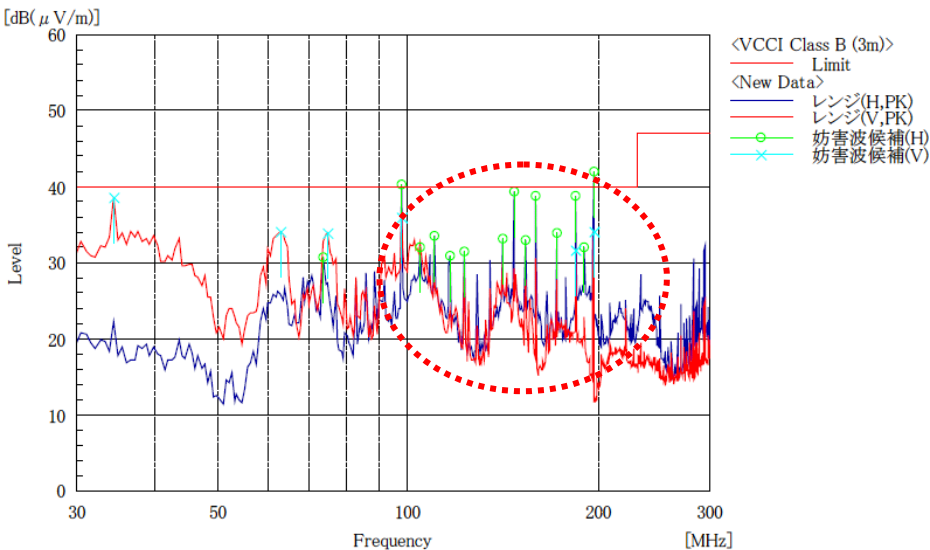


We are currently evaluating the theory and measurements in correlate the Scc21 and EMI measurements. Qualitatively we observed if Scc21 is small, it will make the EMI small.

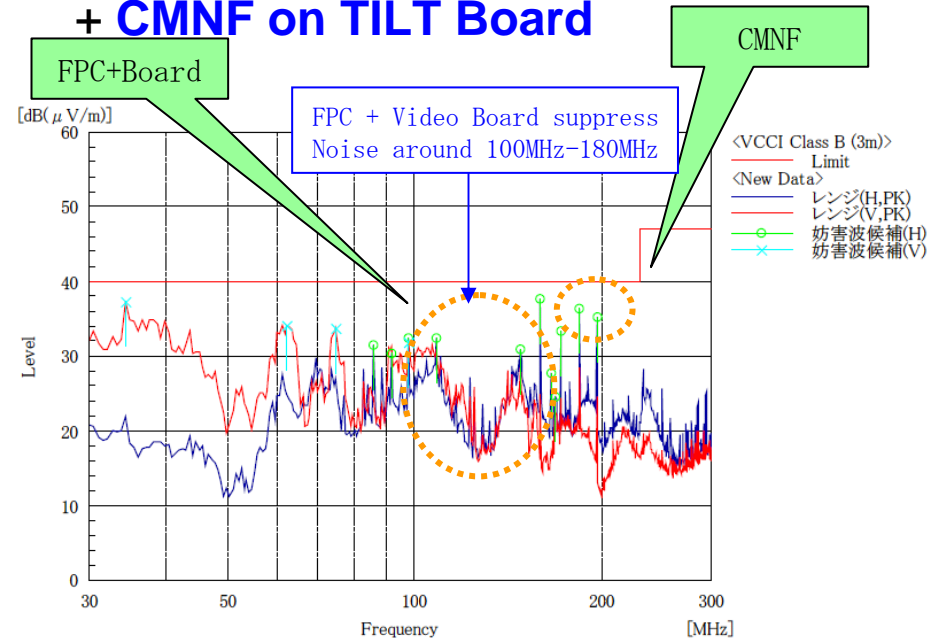


# Measurement on EMI

OLD VIDEO BOARD + FPC-A



NEW VIDEO BOARD + **FPC-B**  
+ **CMNF** on TILT Board



By suppressing the common mode degeneration, we have suppressed the EMI Noise. Confirmed on the LAB.



# Designing quality signal line with Less Common Mode Degeneration

- **Impedance matching** (either from frequency domain and TDR) will result in keeping the quality signal through out the system.
- **Skew Reduction** through out the System will reduce Common Mode Degeneration.
- **CMNF** achieves additional reduction of the **Common Mode Noise**.
- **EMI measurements are done by Panasonic and new Board+FPC+CMNF reduced all the unnecessary noise from the system.**
- **New System maintain good Eye Pattern and Low EMI.**
- **Electromagnetic Simulator** together with **Accurate Circuit Simulator** are the key of pin pointing the cause of the problems



# Acknowledgements

- We like to express deep acknowledgements to **Mr. Higashtiani (PED)** for providing all the precious data to confirm on the Measurements and Simulation comparison.
- **Mr. Kihara and Mr. Suto (PCC)** for providing us prototype board as well as new board. Also all the effort of making EMI measurements.
- **Mr. Noda (Molex Japan)** for providing us the connector models and S-parameters with helpful discussions.

